

# The Chemical Age

OL LXV

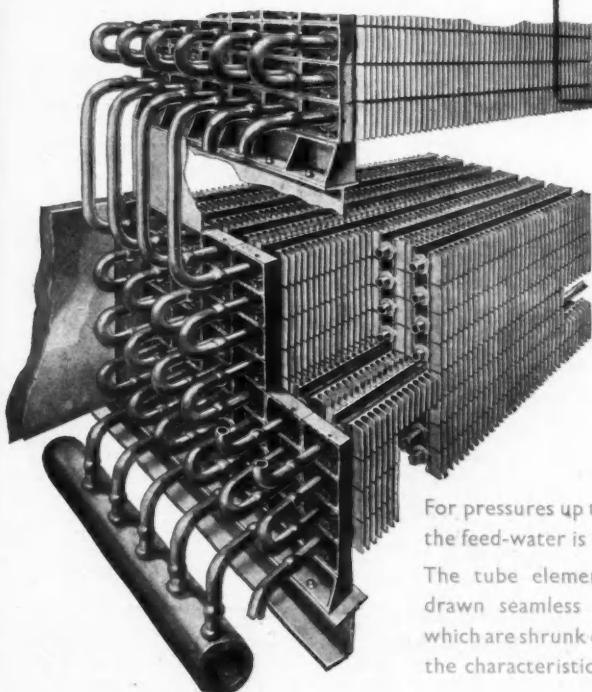
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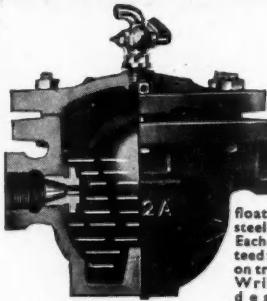
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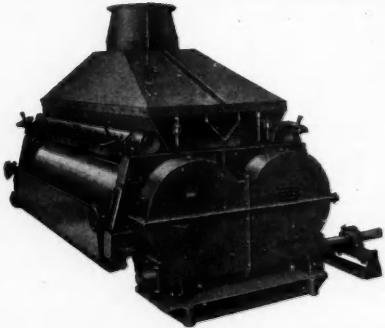
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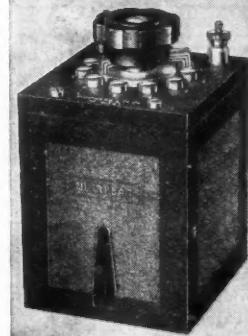
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## INDEX TO ADVERTISERS IN THIS ISSUE

|  | Page         |   | Page        |
|--|--------------|---|-------------|
| Bamag, Ltd.                            | 747          | Laporte Chemicals, Ltd.                   | iv          |
| British Acheson Electrodes, Ltd.       | xvii         | Leigh & Sons Metal Works                  | xviii       |
| Brough, E. A., & Co., Ltd.             | iv           | Lennox Foundry Co., Ltd                   | xviii       |
| Chemical Engineering & Wilton's Patent |              | Lord, John L.                             | Cover iv    |
| Furnace Co., Ltd., The                 | xvii         | Lowmoor Best Yorkshire Iron Ltd.          | x           |
| Classified Advertisements              | xiv, xv, xvi | Metropolitan-Vickers Electrical Co., Ltd. | Cover iv    |
| Clayton, Son & Co., Ltd.               | xi           | Metway Electrical Industries, Ltd.        | viii        |
| Cole & Wilson, Ltd.                    | 750          | Mirrlees Watson Co., Ltd., The            | vi          |
| Cruickshank, R., Ltd.                  | Cover ii     | Mitchell, L. A., Ltd.                     | xii         |
| Drayton Regulator & Instrument Co.     | vii          | Muirhead & Co., Ltd.                      | i           |
| Dryden, T., Ltd.                       | xii          | Powell Duffryn Carbon Products, Ltd.      | ix          |
| Flaig, W. G., & Sons, Ltd.             | vi           | Power-Gas Corporation, The                | v           |
| Gas Council, The                       | 749          | Robinson, L. & Co. (Gillingham) Ltd.,     | xiii        |
| Guest Industries, Ltd.                 | xvi          | Sandiacre Screw Co., Ltd., The            | xii         |
| Haughton's Metallic Co., Ltd.          | xviii        | Senior Economisers, Ltd.                  | Front Cover |
| International Pulverisers, Ltd.        | Cover iii    | Simon, Richard & Sons Ltd.                | Cover ii    |
| Isopad, Ltd.                           | iii          | Steel, J. M. & Co., Ltd.                  | xiii        |
| Kestner Evaporator & Eng., Co., Ltd.   | viii, xviii  | Steele & Cowlishaw, Ltd.                  | xvi         |
| Key Engineering Co., Ltd., The         | Cover ii     | Stewart & Gray, Ltd.                      | Cover iii   |
|  |              | Swift & Co., Ltd.                         | Cover iii   |
|  |              | Tanks & Linings, Ltd.                     | ii          |
|  |              | Wilkinson, James & Son, Ltd.              | xviii       |

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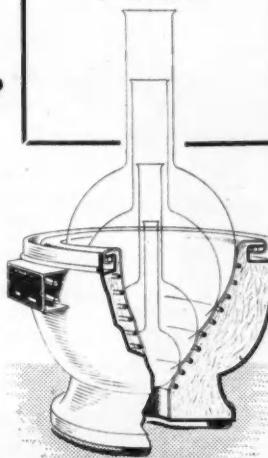
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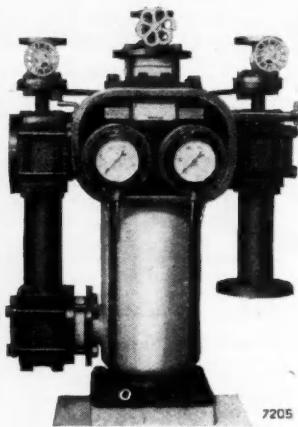
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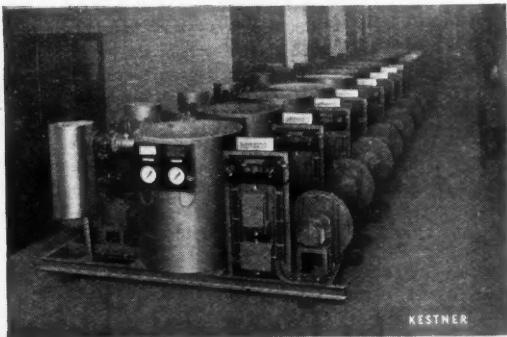
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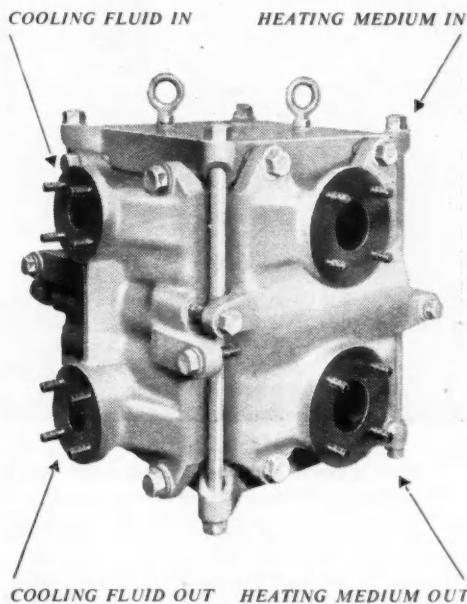
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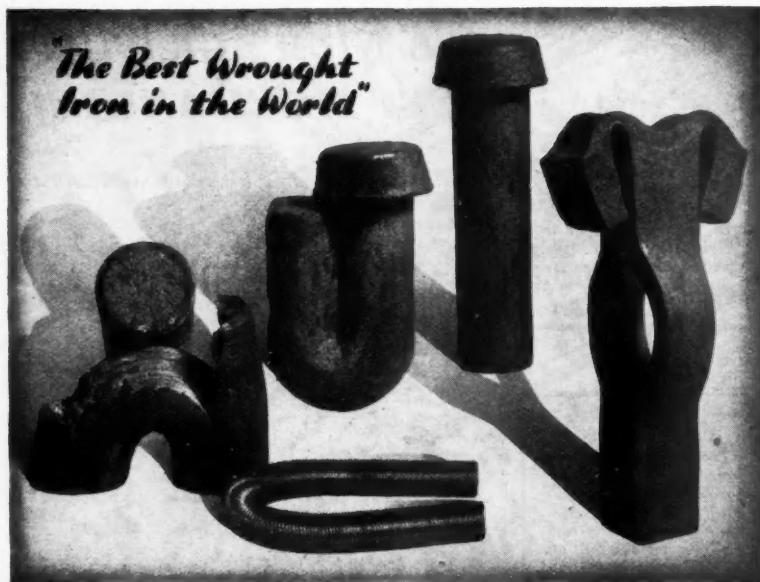
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Volume LXV

1 December 1951

Number 1690

## The Scarcroft Case

By SIR ERNEST BENN

**A**N irregularity of over £30,000 and the appearance of directors in the dock at Assizes are the right material for headlines in the popular Press, and will presently form the basis of political demands for more official action, more forms and further complication of an impossible situation. The Scarcroft Case is, however, just another sample of the system or method of calculated irresponsibility which goes by the name of nationalisation. The details are of little importance and would never have come to light but for the courage and persistence of Mr. Donald Kaberry, M.P. We may hope that the number of cases of such extravagant dimensions is still small, without forgetting that such occurrences are the natural products of the system and that the longer the system is tolerated such abuses must multiply. The human tragedy—surely the appropriate word—is in the growth of a class, now numbering hundreds of thousands, who wield authority without those natural checks and safeguards as essential to any enterprise as the brakes on a motor car, or the safety valve on a steam engine.

The Lynskey Tribunal dealt with cases of a lower order, where graft and corruption took easy advantage of the inherent irresponsibility of public business, but Colonel Lapper and Mr. Newey are suffering penalties for the breach of regulations which themselves would have no place in any system of free competitive economy. Here is a case where officialdom is hoisted on its own petard, bringing out with clarity the hopelessness and helplessness of public enterprise. No great strain on the imagination is needed to visualise the waste inseparable from the operations of officials in almost every section of the national economy, whose actions are necessarily governed by false considerations. They have not to ask whether a proposal is good, wise, useful or whether it will contribute to the national wealth; their chief concern is to know whether it conforms to the letter of Laws and Orders drawn by persons who themselves are seldom able to claim to be judges of the matters so controlled. The Lord Chief Justice himself called attention to the inherent anomaly of a fine of £20,000, imposed by him on a Public Authority which must eventually

be paid by the public nominally served by the Authority.

The private enterprise limited companies, whose functions have been taken over, positively shine by contrast with the murky maze called Nationalisation. Every detail of their doings was the subject of meticulous examination by taxation and other officials, every figure was registered at Somerset House, and once a year every shareholder was able, if he so desired, to submit the directors to the most searching examination. At every level, and at every stage, everyone was liable to be called upon to justify his position. It is positively pathetic to reflect that while 'private' enterprise has nothing private about it, modern public enterprise turns out to be the embodiment of hole-and-cornerism.

Imagine a commercial Limited Company suddenly relieved of the need to hold an annual meeting, with no pressure from anywhere for profit or dividend, with a monopoly of the article produced and complete freedom from competition. Certain things would happen at once, and are happening in all the nationalised

industries today. The staff discovers that the pressure for more help no longer meets with the natural resistance of a sound economy. The inadequacies, real or supposed, of accommodation necessitate larger and better premises. The argument that telephones should be installed in the homes of all officials, over the lower grades, to facilitate the conduct of the business proves to be as sound in theory as immoral in practice. Such details added to the demand for records and statistics, checks, and counterchecks, all go to explain how well conducted profitable enterprise becomes a burden upon the community. The directors of such a company would experience a change of general conditions, agreeable to all but those who are genuinely concerned with the public interest. The half a hundred government departments hitherto regarded as enemies, with all their machinery of forms and enforcement, are transformed, as if by magic overnight, into friends and colleagues, members of the same glorious racket where 'jobs for the boys' is the paramount consideration.

## Notes & Comments

### Overseas Trade

**E**XPORTS of chemicals, drugs, dyes and colours in October rose to a value of £13,630,632. Not only was this over £2,000,000 more than in September, an increase which may be partly attributed to this October being a longer working month, but it was also over £3,000,000 higher than October last year and nearly £6,000,000 better than in the same month of 1949. This has been achieved despite the many difficulties facing the chemical industry and the fact that home requirements are still the first essential. One of the largest individual increases revealed in the *Trade and Navigation Accounts of the United Kingdom* is again benzole, exports of which were 3,529,407 gallons in October this year, compared with 1,055,421 gallons in the same month of 1950. Values of overseas trade for the first 10 months of each year have risen from £72,168,512 in 1949, to

£86,521,104 in 1950, and £117,684,191 this year. A remarkable feature of these totals has been exports to the U.S.A. which were £9,756,705 in 1951 compared with £3,990,464 last year. The Commonwealth has also been one of the largest contributory factors to the increase. Comparison of exports values for the first 10 months of this and last year show the following rises: Australia £8,260,573 (£5,771,883); New Zealand £2,656,082 (£2,434,044); Canada £4,006,826 (£2,939,354) and Union of South Africa £5,779,325 (£3,909,236). That the chemical industry has in the first 10 months of this year achieved exports which exceed in value those of the 12 months of 1950 shows its growing importance to the affairs of the nation. Is it too much to hope that the Government may realise that this contribution could be even greater if the burden of taxation, with its restricting effect on plant replacement, new equipment and so on, was lessened?

## Industry's Resources

THE greatest wrong an employer can perpetrate on his employees is to fail to make a profit.' These words of Samuel Gompers, founder of the American Federation of Labour, might well be considered today by those who, through ignorance or prejudice, agitate against any reasonable margin of gain in industry. A report on the effects of taxation and inflation which deserves attention was published last week. Prepared by a panel set up by the Federation of British Industries, it showed that prices and profits, far from being too high had, on the contrary, been too low to sustain the weight of taxation under existing methods of competition. The amount of undistributed profits put to reserve in the last few years had been inadequate to maintain industry's capital over the years. The panel examined the balance sheets of 80 firms covering the years 1938-49. It was generally accepted that in 1949 average prices of plant, machinery and buildings of these firms was not less than two-and-a-half times those ruling in 1938. The extent to which these firms had been forced to seek funds from outside clearly demonstrated the inadequacy of profits after taxation. The chemical industry is perhaps more seriously affected than many others. Worn plant must be replaced if productivity is to be maintained, let alone increased. Shortage of raw materials has aggravated the posi-

tion, for if substitute materials are to be used or new methods adopted, the outlay required for fresh plant or conversion of old is almost prohibitive.

## Controlling the Boards

THOSE who wishfully suppose that State control of business activity and policy is largely a Socialist tendency would do well to look westwards from time to time, although even here the same writing is discernible on the wall, for the new Government has not dropped the monopoly inquiries started by Mr. Attlee's government. The United States, through the Sherman Anti-Trust laws, has already shown that basic beliefs in free enterprise must be curtailed whenever freedom and enterprise together have managed to build up a mammoth commercial empire or a commonwealth of kindred companies. A new Bill is awaiting Congress discussion, a Bill that is clearly conceived as a practical supplement for the Sherman laws. It is aimed at the prevention of 'interlocking' directorships. It would prevent any director, officer, or even employee of any company with more than 60 million dollars of assets from serving as a director of another such company. Furthermore, should the two companies be in competition, the asset limitation is reduced to only one million dollars. If a company owns less than 50 per cent of the interest in another company it cannot have representation on the board.

## On Other Pages

|                                      |     |
|--------------------------------------|-----|
| Fuel Research Since the War          | 721 |
| Application of Selective Herbicides  | 727 |
| Indian Newsletter                    | 729 |
| The Microscope in Industry           | 731 |
| Aluminium Production                 | 734 |
| Metallurgical Section:               |     |
| Traces of Iron in Zinc and Aluminium | 735 |

|                                |     |
|--------------------------------|-----|
| Distribution of Steel          | 738 |
| Non-Ferrous Metal Supplies     | 738 |
| Metal Finishing Practice       | 739 |
| Personal                       | 741 |
| Home News Items                | 742 |
| Overseas News Items            | 743 |
| Publications and Announcements | 744 |
| Chemists' Bookshelf            | 745 |
| Next Week's Events             | 748 |

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## Effects on Competition Feared

THESE fairly severe proposals have emerged from a Trade Commission Report in 1950. It was felt that too much of America's wealth was controlled by too few directors. Obviously, too, agreements at the board-table to minimise the force of competition are feared by the anti-trust law enthusiasts. Financial circles dislike the new Bill, for there, as here, it has been common practice to nominate 'watch-dog' directors when a bank or insurance company has supplied considerable amounts of capital to a business. The Bill is supported strongly, however, by the American Institute of Management. Chemical companies have more particular reasons for resenting these new limitations that might be imposed upon them. Technical knowledge and directing capacity are not combined in large numbers of men and much of the 'director interlocking' to be found now in the U.S. chemical industry as a whole is a direct result of this shortage. Against this argument, supporters of the new Bill contend that many chemical companies sell only to other companies and therefore tend to ignore their 'responsibilities to the general public'; an enforced incursion of 'outside' directors would give chemical businesses a broader outlook. It is not for this side of the Atlantic to comment upon proposals being made for internal methods of control on the other side. But we may well bear in mind the possibility that in time to come American patterns in the relationship between State and industry may be powerfully advocated here.

## Fertiliser Legislation

THE steady flow of documents from the Organisation for European Economic Co-operation (OECC) is perhaps insufficiently appreciated. Many of these publications have had greater practical and technical value than United Nations' trade or scientific surveys, and this can be said without critical disparagement of the latter. One of the latest issues is a survey of fertiliser trade regulations and laws now in force in the various countries of Europe. It is an exceedingly useful collection of facts.

The design of laws or regulations that will (a) protect the consumer of an essentially technical article, and (b) leave the manufacturer with genuinely workable margins is a most difficult technico-legal problem. Only those who have tried to draw up such regulations can realise the variety of difficulties that the simplest change sets up. Conditions that might be laid down with the utmost technical justice and logic fall down when their impact upon the customs of producer-merchant-consumer trade is considered; *vice versa*, conditions that are wanted by the commercial side of the trade are found to be technically impossible. All countries have had to face these complex problems and probably none of them would claim to have evolved ideal fertiliser legislation; certainly few informed people in this country would point to our own set of laws as a model of perfection. One or two countries in Europe seem to have found the problem so formidable that they have not introduced legislation at all or have suspended regulations previously in force.

## May Lead to Improvement

THE new OECC publication, obtainable through HMSO at 5s. 6d., gives fulsome summaries of the laws and regulations now in force for 14 countries. Chemists and statisticians will note with some surprise that the limits of variation for some of the more common fertilisers vary very considerably in different countries; yet the only really sound approach to this aspect of fertiliser legislation—the statistical examination of manufacturing and analytical possibilities—should lead to fairly rigid consistency. Wide variations in the standards required and in the penalties imposed might be expected but not in the sizes of permissible deviations. It may well be that this new document, which is bound to stimulate comparisons if it is sufficiently widely read, will enable several countries in Europe to improve their fertiliser legislation. Certainly there is everything to be gained by studying the best points in other people's attempts to cope with common problems.

## Fuel Research Since the War

### Study of the Fischer-Tropsch Process

THE last report of the Fuel Research Board was for the period 1939-46 and was largely concerned with the wartime activities of the Fuel Research Station. It was not found possible to publish that report until 1950.

After consideration, it was decided that the present report (HMSO, 3s.) should be made to cover the three years ended 31 March, 1949, and then to return to the pre-war practice of presenting a report annually. A main reason for this was the fact that the period under review was one of transition from short-term researches directly connected with the war effort to the post-war reconstruction projects.

An important change in organisation occurred in 1947 when the Coal Survey and the Coal Survey Laboratories and their staffs were transferred to the National Coal Board. This was achieved so that their work could proceed without interruption. The first task was, of course, repair of war damage at the Fuel Research station and the construction and installation of plant and equipment needed for peace time programme.

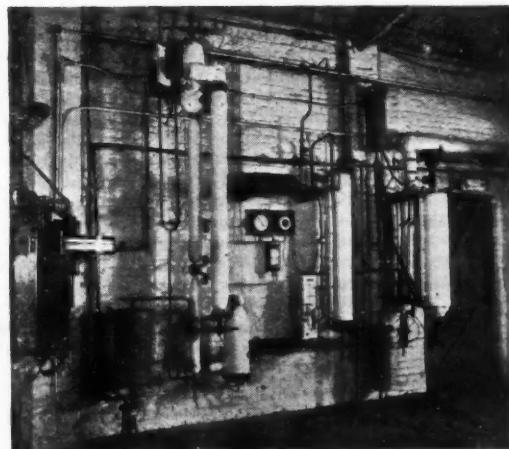
More efficient use of fuel has, naturally, always played a prominent part in the activities at Greenwich, and one aspect now being examined is the possibility of making more

of the larger sizes of coke available from gas works. Normally some of the large coke produced has to be gasified to heat the retorts, but if gas for this purpose could be produced by gasifying coke breeze or other low-grade fuels, about 20 per cent more large coke could be released for sale.

Experiments have therefore been started on the gasification of low-grade fuels, using the 'fluidised-solids' technique, by which the particles of fuel are suspended in a gas stream and are gasified while in suspension.

Physical and chemical examination of coal was carried out under three main heads—constitution, grindability, and agglutinating power.

In the investigations on the constitution of coal, preliminary observation on the distribution of nitrogen and sulphur in the products of the controlled oxidation of Dalton Main bright coal indicated that nitrogen was closely associated with the coal substance, whereas sulphur was not. Vitrain was picked out by hand from the same coal, and from two other coals from the same seam, and the samples were separated into closely graded fractions of increasing density by the float-and-sink method. It was found that, for each coal, the nitrogen was almost uniformly distributed throughout these fractions, supporting the suggestion



Plant for the synthesis of methane using a converter with a moving bed of catalyst

that nitrogen is very intimately associated with the coal substance, and possibly forms an essential part of it.

The distribution of a number of other elements in the fractions was determined by spectroscopic examination of their ash, and the results indicated that the bulk of certain metallic elements, notably vanadium, germanium, and boron, is in intimate association, possibly in chemical combination, with the coal substance, whereas other elements, namely, manganese, copper, lead and cobalt, owe their presence almost entirely to the associated mineral matter.

#### Hydrogenation Application

With a view to applying hydrogenation to the study of coal constitution, attempts have been made to effect the hydrogenation of coal at temperatures below those at which thermal decomposition of the coal would take place in the absence of hydrogen. In the case of Dalton Main bright coal it was found that no materials soluble in chloroform were formed below about 310°C. at 200 atm. pressure, although many different types of hydrogenation catalysts were tried. Similar experiments on ulmins and metal ulmutes have likewise proved unsuccessful.

One of the most important investigations carried out in the carbonisation of coal was an inquiry into the possibilities of recovering 'sulphur from coke-oven gas either directly as elemental sulphur or by way of spent oxide.

In 1948 the Imports Substitution Panel of the Lord President's Committee on Industrial Productivity were examining the possibilities of producing more sulphur in Great Britain so as to reduce the amount imported, and they asked the director of Fuel Research for help in this field. All the processes that are used, or have been proposed, for the removal and recovery of sulphur from coke-oven gas were therefore examined and cost data obtained for them. On this basis a report was submitted by the panel, as a result of which it was decided that two of these processes were sufficiently promising to merit further investigation.

The first was the use of tower purifiers to recover sulphur, initially as tar-free spent oxide, from the coke-oven gas that is at present used unpurified. The second was the extraction of sulphur from spent oxide with carbon disulphide, followed, if necessary, by purification by treating the solution

in carbon disulphide with oleum. It seemed that if the German claims for the technical soundness of this second process were correct it should be successful economically.

At this stage a firm with many years' experience in extracting impure sulphur from spent oxide contaminated by tar was consulted. It was considered that there should be no serious technical difficulty in the production of pure sulphur, either directly from spent oxide containing little tar, or indirectly by extracting contaminated oxide with carbon disulphide and purifying the solution by means of oleum.

Experiments were therefore started on the extraction of sulphur from spent oxide obtained from a coke-oven plant which used electrostatic tar precipitators before the oxide boxes. Simple extraction with no purification gave a product containing 99.90 per cent of sulphur, which is pure enough to be used directly for the manufacture of sulphuric acid. By treating the solution in carbon disulphide with a little oleum the quality was improved to 99.98 per cent. Sulphur of 99.90 per cent purity was also obtained by extracting a sample of spent oxide containing 3 per cent of tar and shaking the carbon disulphide extract with 10 per cent of oleum in stages. The same result was achieved by purifying the extract, again in solution in carbon disulphide, with Fullers' earth.

#### Underground Gasification

In 1946, a Working Group under the chairmanship of the director of Fuel Research was appointed to advise the Ministry of Fuel and Power on the desirability of undertaking underground gasification trials in this country. The Fuel Research organisation, therefore, not only collected published data (mainly Russian) on this subject, but also arranged to obtain first-hand information on the recent Belgian and American investigations. By courtesy of the U.S. Bureau of Mines and the Alabama Power Company, who are jointly carrying out field-scale trials at Gorgas, Alabama, an officer of the Fuel Research Station spent some months co-operating with the American team on the site. The information obtained on the experiments abroad, combined with knowledge of British coal seams and sites likely to be useful for field-scale trials, has been of assistance to the Ministry of Fuel and Power in planning trials now being

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carried out in this country at Newman Spinney, near Chesterfield, and experiments being initiated in Worcestershire, near Kidderminster.

In the section devoted to oils and chemicals from coal, work was carried out on the prevention of sludging and corrosion in the plant used for the production of benzol by scrubbing carbonisation gases with oil, and on the production of valuable ester waxes from peat.

While it was realised that both the recovery of sulphur from coke-oven gas and the Fischer-Tropsch synthesis are processes for the production of oils and chemicals from coal, it was considered better to discuss the recovery of sulphur as a problem of the carbonisation industry and to treat the Fischer-Tropsch process as a method for the synthesis of hydrocarbons.

Enrichment of water-gas by the conversion of part of the carbon monoxide and hydrogen to methane has attracted considerable attention because, if it were economically sound, it would have the advantage of reducing the amount of imported oil that is now used for the production of carburetted water-gas. Work on the synthesis has therefore been continued with a view to collecting information on the technical and economic possibilities of the process.

A reactor to treat 100 to 200 cu. ft. of water-gas per hour was constructed, in which the granular catalyst was placed in a vertical perforated metal cylinder 6 ft. long and 1.25 in. diameter. This cylinder was enclosed in a water-jacketed steel tube of internal diameter 1.80 in. The water-gas entered this tube at the bottom, flowed up the annular space and reached the catalyst by free diffusion. The products of the reaction diffused back into the main gas stream in the annular space. This arrangement was found to be superior to reactors of a more conventional design in that a uniform temperature distribution along the length could be obtained and the temperature could be maintained within such limits that the deposition of carbon was negligible.

It was also found that the hydrogen in the gas was consumed preferentially so that process gases of low  $H_2/CO$  ratio, for example, blue water-gas, could be used without addition of hydrogen. To compensate for the deterioration of the catalyst, part of the catalyst bed was discharged at the bottom from time to time, and a corresponding



(Crown copyright reserved)

*Experimental plant for the synthesis of hydrocarbons by the Fischer-Tropsch process using a fluidised bed of catalyst*

amount of fresh catalyst was added at the top by a gravity feed without interrupting the synthesis. The process gas thus flowed counter-current to the catalyst so that the latter could be used with a higher efficiency and a longer effective life than was possible with a static bed.

The complete plant consisted essentially of a purification system to remove sulphur compounds from the water-gas, a preheater, the reactor already described, with its mechanism for charging and discharging the catalyst, and a thermo-syphon system for circulating water at  $200^{\circ}\text{C}$ . through the jacket of the reactor. With the water in the jacket at this temperature, the catalyst temperature, as measured by a thermocouple in the catalyst space was between  $350^{\circ}$  and  $375^{\circ}\text{C}$ . Using a nickel: kieselguhr 1:1 catalyst, the performance of this plant when producing enriched gas of calorific value 456 B.Th.U. per cu. ft. was equivalent to a yield of 2,100 lb. of methane per lb. of nickel in the catalyst, which had a useful life of 168 days.

By the beginning of 1948 it was considered

that the work on the enrichment of water-gas by synthesis of methane had reached a stage at which sufficient technical information had been accumulated to enable a full-scale plant to be designed and operated if this should ever be required. The investigation was therefore discontinued.

#### Kieselguhr Essential

It was found that the presence of promoters other than kieselguhr was not necessary for the production of active catalysts of long life. Kieselguhr itself, however, appeared to be an essential constituent. Reduced nickel carbonate preparations made without the addition of kieselguhr showed no activity for methane synthesis below 300°C., whereas reduced nickel carbonate-kieselguhr catalysts could be prepared which were active at temperatures as low as 150°C. The most active catalysts were unduly prone to cause carbon deposition, but catalysts which were relatively free from this tendency could be obtained, at the cost of only a slight sacrifice of activity, by choice of suitable conditions of preparation.

Study of the Fischer-Tropsch process at the Fuel Research Station has as its object the assessment of the process as a source of liquid fuels, lubricants, waxes, alcohols and other chemical products. In addition to the work on cobalt catalysts used in the conventional way, investigations of iron catalysts and of the techniques of synthesis with powdered catalysts, either fluidised in a gas stream or suspended in oil, have been undertaken.

Synthesis with a fluidised bed of sintered iron catalyst has been investigated at 300° to 340°C. at 20 atmospheres pressure, using as reactor a steel tube, 10 ft. long and 1 in. internal diameter. This contained 1 kg. of catalyst, graded to the range of B.S. Test sieve sizes 72 to 170.

The synthesis-gas rate was from 750 to 2,050 volumes per volume of settled catalyst per hour and part of the residual gas was recirculated in order to suppress the formation of carbon dioxide and to keep the total gas velocity high enough, 0.4 to 0.7 ft./sec., to maintain the catalyst bed in a fluidised state. Under these conditions, yields of hydrocarbons higher than methane have been obtained, which, expressed as yield per unit volume of catalyst per hour, were up to 30 times those obtainable by the conventional synthesis with a cobalt catalyst.

Considerable operational difficulties were, however, experienced due to deposition of non-volatile products on the catalyst, which in turn caused loss of fluidity and blockages, and also due to the formation of carbon and the resulting disintegration of the catalyst. The carbon appeared to be formed initially inside the pores of the catalyst and to cause the granules to break up. The result of this was that the catalyst bed expanded continuously and losses of catalyst occurred as the finer material was carried over into the condensation system and caused blockages there. In spite of these difficulties, runs lasting from seven to 15 days were achieved.

Another method of overcoming the heat transfer problem, and so allowing reactors of a simple design to be used, is to suspend the powdered catalyst in oil. Unlike synthesis with a fluidised bed of catalyst, this technique is not restricted to mechanically-robust catalysts or to the production of volatile products. Experimental work was started on these lines using a reaction vessel 3 ft. high and 2 in. in diameter, with a standard cobalt catalyst finely powdered and suspended in molten wax (synthesis product). Part of the residual gas was recycled so that the total gas velocity in the converter was high enough to maintain the catalyst in uniform suspension.

It was found that, to obtain results as good as with the conventional fixed bed of catalyst, temperatures 10° to 15°C. higher were required. Attempts to maintain the yield at space velocities higher than 200 per hour caused the catalyst activity to fall off rapidly. Contrary to expectation, the products obtained by liquid-phase synthesis were more volatile than those obtained by normal operation at the same temperature. Experiments are now in progress with a sintered type of iron catalyst.

#### Cobalt Catalyst

A freshly-reduced cobalt catalyst did not, it was found, give the X-ray diffraction pattern of cobalt. The interpretation that the catalyst does not contain bulk metallic cobalt has been confirmed by measurements of the surface areas of the catalysts and their components. It is therefore considered that the reaction takes place on isolated cobalt atoms, and not on bulk metallic cobalt or by way of bulk cobalt carbide.

Evidence has been obtained which suggests that, under certain conditions, methane

present in the synthesis gas can take part in the reaction. It was also found that the wax formed on the catalyst during synthesis reacted with hydrogen under synthesis conditions to give higher hydrocarbons distributed among the different molecular sizes in a way similar to the distribution of the synthesis products. These two facts, taken in conjunction, suggested that the final stages of synthesis involve a polymerisation—depolymerisation equilibrium.

When synthesis is carried out at abnormally low temperatures and low times of contact, appreciable quantities of alcohols are present in the products given by cobalt catalysts. These results, together with observations on the decomposition of alcohols under synthesis conditions are consistent with the view that the alcohols are the true primary products of the synthesis reaction. This work on alcohols is being continued.

Work on the synthesis of lubricating oils from the primary products of the cobalt catalyst process has now been completed and published, and also that on the production of fatty acids by the oxidation of high-boiling fractions of synthesis product. Attempts to purify the soap prepared from synthetic fatty acids, so as to prevent it causing an unpleasant smell to develop on the skin after washing, have been unsuccessful. Experiments with specially synthesised acids of various types have confirmed the statement that soaps made from branched-chain fatty acids possess this property, but it has not been proved that the presence of such acids is the sole cause of the undesirable properties of the soap made from Fischer-Tropsch raw materials.

#### German Documents

A considerable amount of time has been devoted to the study of the mass of captured documents brought back from Germany by the various teams of field investigators in 1945. The main results of this work have been summarised in Section D of the Ministry of Fuel and Power's Report on the Oil Mission. A special visit was paid to Germany by two members of the staff in 1946 to fill a number of gaps in the earlier information. When two of the synthesis plants in the Ruhr were restarted in the following year, two members of the staff took part in a visit to study them under working conditions.

Experimental work on the removal of sul-

phur from flue gas has been carried out since 1947 in close co-operation with the DSIR Working Group on the removal of sulphur compounds from industrial gases, of which the director of Fuel Research is chairman.

#### Generating Stations Scrub Gas

Generating stations of the British Electricity Authority are required to remove the greater part of the sulphur compounds, sulphur dioxide and trioxide, from their flue gas. Processes used for this purpose consist of washing the flue gas with water containing alkali, present either as natural hardness or introduced as a suspension of milk and lime. Since every ton of coal burnt produces nearly half a million cubic feet of flue gas, and since the concentration of sulphur compounds in this gas does not exceed one part per thousand, a large and expensive scrubbing plant is required to remove these compounds.

In order to find a cheaper process a large number of proposals have been examined and a selection made of those considered to be worth further investigation. Of these suggestions, the following have been studied experimentally.

*New Catalysts for the Oxidation of Sulphur Dioxide in Solution.* The rate of absorption of sulphur dioxide in a scrubber can be raised by increasing the rate at which it is removed from the liquid side of the gas-liquid interface, and one way of doing this is to add oxidation catalysts to the scrubber liquor. Work on oxidation catalysts has been carried out with very simple experimental arrangements in which air containing 0.2 per cent of sulphur dioxide and 8.6 per cent of carbon dioxide was bubbled through a column of water containing the catalysts under investigation.

In an attempt to find catalysts that might be more active than the iron and manganese salts that are in common use, salts of chromium, copper, vanadium, and aluminium were tried, but with the exception of vanadium none gave promising results. It was found that copper is not a good oxidation catalyst under these conditions, whereas it is well known to be very effective in neutral or alkaline solutions. This emphasises the importance of choosing the catalyst to suit the pH value of the washing liquid in the scrubber.

*Oxidation Inhibitors.* When it was decided to use oil-fired boilers at the new

generating station at Bankside, fears were expressed that various organic substances, which might be produced by the incomplete combustion of oil, would act as inhibitors for the oxidation of sulphur dioxide in the flue-gas scrubbers. It was found that when scrubbing with water containing 0.003 per cent of manganese, as  $MnSO_4$ , as the catalyst, phenol, cresol and xylanol acted as inhibitors at concentrations as low as 0.005 per cent, and the action of the polyhydric phenols, catechol, resorcinol, and pyrogallol was so powerful that they stopped the oxidation altogether, even at this very low concentration. No sign was observed of the inhibiting effect of these substances changing over to a positive catalytic effect at still lower concentrations, as is known to occur when they are present during the oxidation of indene.

#### Use of Dry Alkali

On account of the expense of gas washing processes, due mainly to the large size of the plant required, suggestions have been made for the removal of sulphur dioxide by dry alkaline absorbents injected as powders into the flues leading from the boilers. Experiments were carried out on the effect of chalk in removing sulphur dioxide from a 5 per cent mixture of this gas with air at temperatures between 400° and 750°C. It was found that the extent of reaction was negligible below about 550° and 600°C., and, as the amount of sulphur dioxide in the gas was decreased, higher temperatures were required to bring about the reaction. Thus, injection of chalk into flue gas would be completely ineffective, as the temperature of the gas leaving the boiler is not usually more than 150°C.

*Electrical Oxidation.* Before the war statements were published that sulphur dioxide had been successfully removed from flue gas in Russia by oxidation in a silent electrical discharge followed by removal of the resultant sulphur trioxide fog by electrostatic precipitation. Very few details of the process were given.

Preliminary calculation showed that if the oxidation of sulphur dioxide required the formation of ozone as the first step, or if it required as much electrical energy as that for the production of ozone, the process would be too expensive to be worth further consideration. If, however, the rate of oxidation were several times greater than the rate of formation of ozone, the process

might well be more favourable economically than flue-gas scrubbing.

Experiments were carried out with dry gas at room temperature and they indicated that the amount of sulphur dioxide oxidised was about equivalent to the amount of ozone that would be formed under the same conditions, but more work with wet gas at higher temperatures is required before the possibilities of the method can be properly assessed.

Other work carried out in connection with boilers and steam-raising included comparative trials of  $CO_2$  recorders; an investigation on the sampling of flue dust; and the determination of particle size.

Atmospheric pollution was the object of a good deal of observation, but is only briefly covered in the present report as a detailed account of the work is being published separately.

Among the extra-mural investigations which formed part of the programme of the Fuel Research Board, work has been carried out in Sir Cyril Hinshelwood's laboratory at Oxford on the thermal decomposition of *n*-pentane. The reaction was studied kinetically by the measurement of pressure change in an apparatus which consisted essentially of an electrically heated furnace, a silica reaction bulb, and a capillary manometer. The results obtained are consistent with the assumption that the normal decomposition is made up of a molecular rearrangement process and a chain reaction, which later can be suppressed by nitric oxide.

#### Molecular Rearrangement

Analysis of the products of decomposition by the molecular rearrangement reaction indicated that the probability of an initial rupture at the  $C_{2,3}$  linkage is about twice that of rupture at the  $C_{1,2}$  linkage. When the molecule breaks at the  $C_{2,3}$  bond the probability of the formation of ethane and propylene is greater than that of the formation of ethylene and propane. The mechanism of the chain reaction appeared to be generally similar to that observed in the decomposition of ethane. Work on the thermal decomposition of *n*-hexane has been carried out along similar lines.

A number of developments arising from wartime projects not directly related to the normal programmes of the station were continued.

## Application of Selective Herbicides

### Academic and Industrial Problems Discussed

**SELECTIVE** Phytotoxicity of 2,4-D and MCPA in Wheat, Oats and Barley was the theme of a symposium held by the Crop Protection Panel of the Agricultural Group of the Society of Chemical Industry, at the Royal College of Science, London, on 6 November.

In the absence of Mr. W. E. K. Piercy, who was still in the U.S.A., the chair at the opening session was taken by Sir Harold Tempany, who, after welcoming the speakers and the audience of some 125 members and visitors, called upon Professor G. E. Blackman (Department of Agriculture, University of Oxford) to introduce the symposium.

Experiments on the use of synthetic growth regulators as herbicides, said Professor Blackman, began in 1943 and since then their use had expanded greatly. No small factor in this expansion had been the development of the low volume sprayer, which opened the field of application to the individual grower, as well as to the large contract sprayer.

Such development had necessitated considerable research into the accurate timing and methods of application of these selective herbicides to ensure that the maximum benefit accrued from their use. Industrial and economic aspects of these problems would be discussed during the symposium.

#### Influences on Toxicity

The chairman then called upon Dr. W. E. Ripper (Pest Control, Ltd.) to read his paper 'The Relative Toxicity of 2,4-D and MCPA to Annual Weeds.' With a few exceptions, said the doctor, there was little difference. In experiments against *Brassica alba*, the toxicity ratio of the two materials was influenced by the interval between spraying and observation, the incidence of rain after spraying, the concentration applied and the salt used. Dr. Ripper suggested that the greater solubility of sodium MCPA and the fact that its spray deposits were 'syrupy' rather than crystalline, as was sodium 2,4-D, might account for its greater speed of action.

'Relative Toxicity of 2,4-D and MCPA to Wheat, Oats and Barley,' was the subject of the second paper by Dr. H. P. Allen (Plant Protection, Ltd.), who said that the main

manifestations of toxicity to cereal crops were malformations and yield reductions. These were not necessarily correlated. Because of the compensating effects which accrued from the application of the weed-killer to a weedy crop, the information of greatest value was that obtained from a study of clean crops.

#### Relative Susceptibility

Quoting from the literature as well as from his own work, Dr. Allen first discussed the relative susceptibility of the three cereal crops to abnormalities in general, and then as a result of treatment with 2,4-D and MCPA. He then dealt with the yield reductions caused by the two chemicals in each of the three cereals. Direct comparison of all published work was difficult because of the many outside factors influencing the results, namely, the chemical nature and formulation of the compound under test, the time of the application, varietal susceptibility, and soil and climatic factors.

For the final paper of the first session Mr. J. D. Fryer (ARC Unit of Experimental Agronomy) spoke on '2,4-D and Cereal Damage.' Since the introduction of the chemical and of MCPA to British agriculture five years ago, said Mr. Fryer, cases of serious damage to cereals as a result of treatment had been very few. Occasional damage to spring cereals by 2,4-D amine had however been reported following its increased use since the introduction of low volume spraying in 1948. This had raised some doubts as to its suitability for the treatment of spring cereals.

Commercially recommended rates for the use of 2,4-D amine varied considerably, and since it was more efficient than sodium MCPA at low dosages for many annual weeds, with a correspondingly lower cost per acre, the ARC unit at Oxford had begun a long term series of co-operative trials with the NAAS. Preliminary results from the 1951 trials and the types of damage which had sometimes occurred were discussed by the speaker.

A general discussion was then opened by Dr. Dillon Weston (NAAS) who summarised the results of experiments he had carried out in 1949/50.

He confirmed the findings of Swedish and Danish workers that in barley, 2,4-D amine gave more distortion than sodium MCPA. He had observed gross stunting and a high proportion of tweaked ears in barley sprayed with 2,4-D at 1 and 2 lb./acre. Grain samples from the treated barley were irregular in size and the malting quality was reduced. The seed from affected crops did not inherit these irregularities.

Sir Harold Tempny asked whether the use of growth substances could affect the protein content or increase the yield of cereals. According to Dr. A. J. Lloyd increases in protein yields of wheat after spraying with 2,4-D had been reported from the U.S.A.

#### Palatability Altered

Increase in protein content usually meant reduction in yield, said Dr. W. G. Templeman. The phytocidal effects on foliage were accompanied by a depletion of the available carbohydrate in the root. The palatability of herbage could be altered by spraying with MCPA.

Professor R. L. Wain pointed out that it was definitely established that the presence of growth regulators, which were 'foreign' molecules, within a plant could alter the distribution and composition of the normal constituents present; it was to be expected that this would influence the normal plant biochemistry.

Spraying barley at the *boot* stage with 2,4-D amine at 1 lb./acre was found by Mr. E. C. Large to have caused no ear distortion. There were, however, obvious application difficulties in this technique. Dr. W. E. Ripper pointed out that these could be overcome by aerial spraying.

After an interval for tea the symposium was resumed under the chairmanship of Professor R. L. Wain (Wye College) who asked Mr. K. Carpenter (May & Baker, Ltd.), to read his paper on 'The Relative Toxicities to Plants of Amine and Ester Formulations of 2,4-D.'

It had been shown, said the speaker, that against susceptible weeds in average crops, and at very low rates of application (up to 8 oz./acre) the ethyl ester of 2,4-D was more effective than the trimethylamine salt. At higher rates of application this difference was less marked. The range of weeds controlled was similar, but the ester was more effective on the less susceptible species. These differences had been shown to be due

to the addition of oil and emulsifier in the ester formulation. The increase in weed control was balanced by a smaller safety margin. The safe recommended application rate of 2,4-D ester was 8 oz./acre except for oats which were more susceptible. The amine could be used at 2 lb./acre and over.

'Effects of Volume Application Rate on the Activity of 2,4-D and MCPA' in relation to the results of field and greenhouse experiments were next discussed by Mr. K. Holly (ARC Unit of Experimental Agronomy). Investigations with barley and *Brassica alba* had shown, he said, that changes in the proportion of the spray retained could vary considerably. Possible effects of volume rate on the penetration of 2,4-D and MCPA into plants and the relation of environmental factors to the problem were also reviewed.

'The Mode of Action of 2,4-D and MCPA' was the subject taken by Dr. E. K. Woodford (ARC Unit of Experimental Agronomy), who stated that very few direct comparisons had been made of the relative toxicity of 2,4-D and MCPA as herbicides in bio-assay tests. Results indicated that in field tests with plants differences were larger than in laboratory tests with isolated tissues.

As 2,4-D had been studied much more than MCPA, a detailed comparison of the mode of action of these two chemicals was not possible. Such differences as had been observed were, however, considered by Dr. Woodford with reference to the entry into and the transport within the plant of the growth regulator and its effect on cellular processes.

#### Persistence Factors

Professor L. J. Audus (Bedford College) then presented the concluding paper 'The Decomposition of 2,4-D and MCPA in the Soil.' Persistence in the soil was favoured by low moisture content, low temperature, low organic content and soil sterility. Using a modification of the Lees and Quastel perfusion technique the professor showed that, after an initial lag period of a week or more, there was a rapid disappearance of 2,4-D and MCPA in the soil. In the case of 2,4,5-T the time lag was over nine months. This suggested the establishment in the perfused soil of a herbicide-metabolising micro-organism. The breakdown was prevented by the bacterial poison  $Na_3$ . Experiments using 2,4-dichlorophenol suggested that this compound might be intermediate in the breakdown of 2,4-D.

## Indian Newsletter

(From Our Own Correspondent)

ONE of India's largest chemical projects came into fruition at the beginning of last month when the Government-owned 23-crore Sindri Fertiliser Factory, in the heart of the Jharia coal fields, started production of ammonium sulphate. The target of 1,000 tons a day is expected to be reached in the course of the next few months. It is hoped that Sindri will provide sufficient fertiliser for agriculture to enable India to become self-sufficient in the matter of food.

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Sulphur is the cry of the hour in India. What might be termed a 'Pyrites Rush' is now taking place following the recent discovery of pyrites by a private miner in the southern hilly tracts of Karwar in Bombay State. Private firms are evincing keen interest in the deposits which are estimated to be extensive. The pyrites are stated to contain 51 per cent sulphur, 5 per cent nickel and 1 per cent copper, while it is reported that 120,000 tons of the ore could be mined annually according to a conservative estimate by geological experts. In addition to meeting the acute sulphur shortage in this country and thus supplying the 43 plants manufacturing nearly 100,000 tons of sulphuric acid annually, the other two elements in the ore, copper and nickel, would be valuable additions. A geologist deputed by the Government of India is expected to investigate the site shortly.

Other means for augmenting the sulphur resources are receiving active consideration. It has been known for some time that pyrites are found in Wynad in the Nilgiri district, and Polur in the North Arcot district of Madras State. The Geological Survey of India is investigating the reserves of sulphur in these areas by geophysical means.

Investigations have also been made on the bacteriological formation of sulphur in Masulipatam but the quantities to be expected are rather small.

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Lignite deposits have also been the subject of investigations under the Geological Survey of India. Vast quantities of lignite at an average depth of 160 feet are expected to be available in the area of Neiveli in South Arcot (Madras). Mr. Paul Eyrich,

of the U.S. Bureau of Mines, has arrived under the Point Four Programme (aid to undeveloped areas) to assist in the mining operations.

Lignite was discovered in this area between 1943 and 1946, but the existence of artesian springs above and below the lignite deposits made the work difficult. In October, 1950, a fresh attempt was begun by surveying the area and sinking fresh pits, and the first bulk samples were taken out towards the end of last month. Mining by open cast method, it is considered, might be an economical proposition as the ratio of lignite to the overburden rarely exceeds 1.3, and the overburden consists of high alumina clay which is useful for the ceramic industries.

The Government of India has consulted a number of experts and firms among whom may be mentioned Professor J. A. S. Ritsan, Royal School of Mines, London, Mr. J. C. Mitcheson, consulting mining engineer, Staffordshire, and Powell Duffryn, Technical Services, Ltd., London. It is pointed out that if the six-feet-thick lignite deposit, at a depth of 600 feet, with 4 per cent montan wax, could be worked economically in Devonshire, England, possibilities of the Indian lignite occurring less deeply and with a higher percentage of montan wax are even greater.

Tests so far conducted reveal that the moisture, sulphur and ash contents of the lignite are low and with suitable processing the calorific value would be fairly high. Further tests on bulk samples are under progress in several laboratories in India and abroad. Potential applications of the lignite find are as a direct fuel for the generation of power, for the extraction of montan wax, fractional distillation, and for the gasification of residual lignite for producer gas. Two committees have been appointed to advise the Government in regard to the development programme.

\* \* \*

Discovery of an uranium vein is claimed by a private miner at Bhema in a mica belt in the Manbhum district of Bihar. A reward of Rs.10,000 for the successful exploration of new uranium ores with a minimum of

0.4 per cent uranium oxide content was first announced by the Government of India in April, 1950. The new Bihar find falls short of the specification by having only 0.12 per cent of oxide. It is understood that the miner has requested the Indian Atomic Energy Commission to assist him in the beneficiation of these ores or alternatively to permit him to export them. In the same area, he also claims to have found considerable quantities of beryl analysing to 11.1 per cent of beryllium oxide and has forwarded bulk samples to the Government of India for trial.

\* \* \*

In view of the recent decision by the Government of India to allow the export of 1,000,000 tons of high-grade manganese ore, Great Britain may receive larger shipments of ore in the current year. The Gold Coast ranks as the largest supplier of the ore to the U.K. and the share of India is nearly 25 per cent now compared with the 84 per cent in 1918. No restriction will be placed on the export of low-grade ore, and in view of the stock-piling of reserves in the U.S.A., the bulk of the trade is being diverted towards that country. Exports for the year April, 1950-March, 1951, were (in tons):—United Kingdom, 67,999; U.S.A., 354,617; other countries including Germany, France, Italy and Japan, 110,425.

Manganese ore shipments to United Kingdom will have to be reviewed early next year in the light of current British buying interests.

## Hot-Spray Technique

### Larger American Market

IN our issue of 20 October, 1951, we reported the conference held at the Waldorf Hotel, London, by the Hercules Powder Company, on the hot spraying of nitrocellulose lacquers. It became evident then that British manufacturers of this commodity have not lagged behind the Americans in technique, and, if anything, are actually ahead of them in many respects. More information on this aspect of the subject has recently come to hand.

The main difference between this country and America regarding the use of hot lacquers is that while we have a superior lacquer, in that it contains 40-42 per cent solids as against a usual 30 per cent in

America, we lag behind Americans in developing its uses. The Americans are already using the hot-spraying technique for cars, textiles and furniture, but at the moment, although recent events promise an expansion in the market at home, British uses for the lacquer are largely confined to furniture finishing. Used in this way it has the big advantage over cold lacquer of saving labour in the application of coats, although the finish of the two types is practically the same. Generally speaking, this and the saving of time are the greatest advantages of the hot-spray technique. It is otherwise better in the case of most surfaces to have two coats of cold lacquer instead of one of hot, as this gives greater flexibility to the lacquer film. Hot spraying does, however, permit the use of pigmented lacquers, which are otherwise unusable.

The reason that the Americans use less solids in their hot lacquer than we do is that the 'cold check' problem, or the variation between extremes of temperature and humidity at which the lacquer may have to be used, is far more acute there than it is in Britain. The lacquer in America may have to be used in sub-tropical or near-Arctic conditions, and lacquer with a high solids content deposits a thick coating which cracks under these severe conditions.

### Salesmen More Go-Ahead

The use of hot-spraying technique, however, is greater in America than in this country mainly because the salesmen of the lacquer and especially of the equipment firms are more go-ahead than ours. This has led to American firms attempting to get their equipment manufactured on licence over here. Another reason that has impeded our own equipment manufacturers is the fact that the Home Office has until recently been hesitant about granting licences for the equipment, due to a slight danger from vapour. The equipment was not considered completely vapour-proof and did not satisfy all the petroleum regulations. More recently, however, the designers have overcome this difficulty, and for the past six months equipment has been in production which has Board of Trade approval.

It is hoped in the industry that this will give an impetus to equipment manufacturers to advertise the hot-spray technique more widely, and discover markets for it not at present exploited.

## The Microscope in Industry

### Wide Variety of Uses on Show

**A** N interesting exhibition on 'How Industry is Using the Microscope' was held in London on 21 November by the Industrial Section of the Royal Microscopical Society. Opening the exhibition, Mr. A. J. Philpot, C.B.E., M.A., B.Sc., F.Inst.P., said that he was most gratified to see so many firms represented at the exhibition by their research sections. The microscope, he said, was a scientific instrument in a unique position. It had made possible by itself the most startling advances in fields of all kinds, and now that the electron microscope had come into being, the range of the instrument was increased still further. The two, however, he said, did not clash, but each was applicable to its own field. The electron microscope did not in any way outmode the optical instrument. Indeed, each reinforced the other.

One of the stands which attracted a lot of attention was that of the National Coal Board. This showed a projection microscope for checking samples of air from mines for the number and size of dust

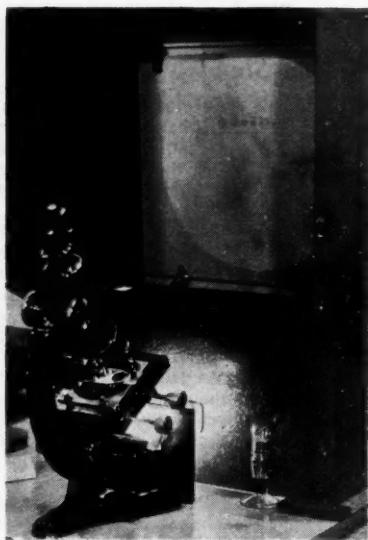
particles, which are evaluated by this means. The Fuel Research Station of DSIR also showed methods of identifying flue dusts and boiler deposits under the microscope as a quicker and easier substitute for lengthy chemical analysis.

An interesting demonstration of how a detergent works was on view on the British Laundry Research Association's stand. This consisted of a projection microscope unit in which an optical cell was mounted on a mechanical stage, the cell containing soiled textile fibres which were projected (x 300) on to the screen. As detergent solution was added to the cell, the drops of oil were seen to detach themselves easily from the fibre. A novel feature of the unit was the single lever control of cell movement and focussing.

I.C.I. had three stands on show. One, exhibited by their Paint Division, showed electron micrographs (x 25,000) of the development of various defects such as 'chalking' on paint surfaces. Other photographs showed a technique using metal-shadowed replicas with the electron



*The stand on paint research exhibited by ICI Paints Division*



*The projection microscope shown by the National Coal Board*

microscope, and these showed the development of 'bloom'. Sizes and shapes of varying pigments used in paint were also on view in electron micrographs. The use of the microscope in research was the subject of their second stand, which displayed electron micrographs of heat-treated steels. These possess a 'sigma phase' which is believed to cause brittleness. A microscope slide of sulphur-oxidising bacteria which can live in a pH of 2.0 or less was on view, together with thin sections of anhydrite from Billingham, used to detect silica impurities. I.C.I.'s other stand was concerned with metallurgy and the recognition of solid phases in a metal or alloy, the detection of porosity, inclusions, and other defects, as well as the measurement of plating thickness, etc.

Another stand concerned with defective inclusions was that of Sheffield University's Glass Technology Department, which was showing crystalline inclusions in the glassware on the stand. A valuable way of identifying the materials of which these 'stones' consist is with the petrological microscope.

The Thermal Syndicate exhibited an interesting demonstration of fluorescence micro-

scopy. A lamp was shown which was capable of piping light down a solid quartz tapered tube to give a point source of light of great intensity at its extremity. Used for u.v. light which is reflected up the microscope with a surface aluminised mirror, the fluorescing of the material in the slide gives a clear picture of the section without dazzling the eye.

A most interesting stand was that of the Plant Virus Research Unit showing electron micrographs of polyhedral disease in caterpillars. The virus rods emanating from the dissolved crystals appeared quite clearly in these micrographs. Such a technique is invaluable for virus research.

#### **The NPL Display**

The National Physical Laboratory of the DSIR displayed a Zeiss Linnick micro-interferometer with interferograms taken with the instrument of various surfaces. These included pictures of the surface finish of ground specimens and an interesting micrograph showing grooves in the surfaces of balls used in precision bearings. Photo-micrographs and diagrams also illustrated the use of the interference, polarising and phase-contrast microscopes in metallography, particularly with regard to the study of creep in aluminium.

A reflecting microscope for use with an infra-red spectrometer was exhibited on the stand of Courtaulds, Ltd. Using spherical components, the instrument is used chiefly with the infra-red polariser for examining the orientation of polymer molecules in films, fibres, etc., and it has enabled the infra-red spectrum of single protein crystals to be examined. A condenser illuminates the specimen and an image is produced on the spectrometer slit. Magnification is five diameters and the light-grasp is sufficient to illuminate the spectrometer collimating mirror.

British Drug Houses had a colourful stand on the testing of microscopical stains. Micrographs of stained tissue were on show and some of the techniques used in the routine tests were demonstrated.

Glaxo Laboratories devoted their stand to showing the use of the microscope in antibiotic research and production. The isolation of single spores for research in fungal genetics and the experimental induction of mutations was demonstrated, as also was the detection of casual infecting organisms in fermentations as a check on sterility.

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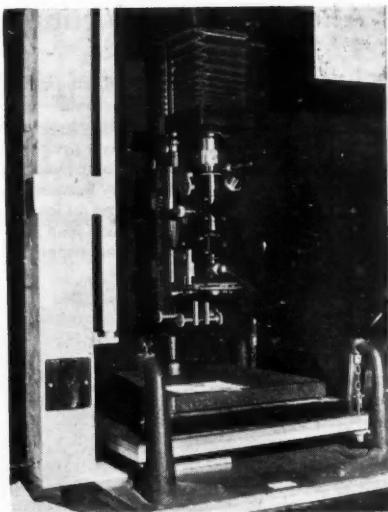
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High temperature microscopy can be carried out by using a small vacuum furnace with a quartz window in the lid. The stand of Cambridge University's Department of Metallurgy showed this with microscope and 35 mm. camera in position. Also exhibited was the technique employed for examining known areas of a metal specimen with an electron microscope. The Cavendish Laboratory from Cambridge displayed two methods for making thin plastic replicas.

A speedy method of assessing the preferred orientation of crystals in silicon-iron transformer laminations for specification and research purposes is with the optical microscope. Two such methods were exhibited by the British Thomson-Houston Co., Ltd.—a simplified goniometric method, and one using polarised light. Both the orientation of the exposed planes in a crystal and the degree of preferred orientation in a poly-



*The examination of preferred orientation in silicon-iron strip, as demonstrated by The British Thomson-Houston Company Ltd., of Rugby*

crystal may be determined by these methods.

Application of the electron micrograph for determining such things as the size of the diamond particles used for polishing diamond wire-drawing dies and the physical form of vapour-deposited carbon was shown by the General Electric Co., Ltd. Photomicrographs were also on view to show the depth to which hardness penetrated in case-hardened carbon steel.

A large stand by the British Ceramic Research Association showed the application of the microscope to the pottery and refractories industries. Electron micrographs of clay minerals and photomicrographs of pottery faults.

Leather microscopy was demonstrated ably by the British Leather Manufacturers' Research Association. The quality of a leather may be assessed by a study of the features of fibre structure with the microscope, and changes in fibre structure during processing may be followed. Various typical leathers were shown, with micrographs of their fibres. Jute fibres may also be usefully studied microscopically, and the British Jute Trade Research Association demonstrated this.



*The surface contour of a small area of surface being examined with a Linnick micro-interferometer displayed by the NPL. Interference fringes are observed at a magnification of 500 times between the reference optical flat and the surface under examination*

## Aluminium Production

### World Supply Increasing

THE world supply position of aluminium seems to be fairly satisfactory and there appears no serious anxiety regarding the future. Construction of Norway's proposed new plant at Sundalsøra is expected to start soon. Steel and machinery have been ordered from Norwegian and German firms and it is reported that a ten-year contract has been negotiated for the supply of Canadian alumina.

France's output of aluminium this year is expected to reach 90,000 tons, which would be 50 per cent more than the 1950 figure. The two firms which between them account for France's entire production of virgin aluminium—Pechiney and Ugine—produced some 70,000 tons in the first nine months of this year, which was a new record made possible by the progress of the industry's modernisation programme and the improved supply of electric power.

### Jugoslav Plant Progressing

Meanwhile, it is learned that at the partly completed Jugoslavian aluminium plant at Strnišće in Sovenia, a certain amount of machinery and plant has now arrived. The plant, however, is unlikely to be working for a year or two at least. Its capacity is planned at about 30,000 tons a year.

In Spain the Empresa Nacionale del Aluminio at Valladolid, is building an extension to double its present capacity of 2,500 tons of ingots a year.

In the United States, the Kaiser Aluminium and Chemical Corporation has announced plans to double its aluminium reduction plant and power facilities now under construction in the New Orleans area, whereby the Government guarantees to purchase five full years' production from the new 100,000-ton-a-year plant. Cost of additional facilities, together with various improvements, is placed at approximately \$100,000,000. The first aluminium is due to be poured at the first New Orleans plant next month, thereby scoring a construction record of bringing in new aluminium production less than ten months after construction was started. Upon doubling of this plant, Kaiser Aluminium's total capacity will be raised to 400,000 tons of primary aluminium a year.

## Chemical Research Awards

AWARDS of new Fellowships for chemical research for 1951-52 have been made by the Ramsay Memorial Fellowship Trustees on the recommendation of the Advisory Council as follows:

Mr. L. E. Lyons, a British Fellowship of £500 a year at University College, London; Mr. James Jack, a Glasgow Fellowship of £500 at the University of Cambridge; Dr. K. O. G. Kutscke, a Canadian Fellowship at the University of Leeds; Dr. Serafin Novoa, a Spanish Fellowship at the Agricultural Department, Oxford; Dr. Garcia de la Bando, a Spanish Fellowship at the University of Bristol; Dr. Margaret D. Cameron, a United States Fellowship at the University of Leeds.

The British Ramsay Fellowship, held by Dr. E. Gelles in 1951-52 has been renewed for a further year, and an extension of four months has been granted to Mr. H. Mendel (Netherlands) at the University of Oxford.

The above awards involve the re-establishment, with the co-operation of the Fulbright Commission, of the United States Fellowship which has been in abeyance since 1928. They also include a second Spanish Ramsay Fellowship.

## Sales Organisation Set Up

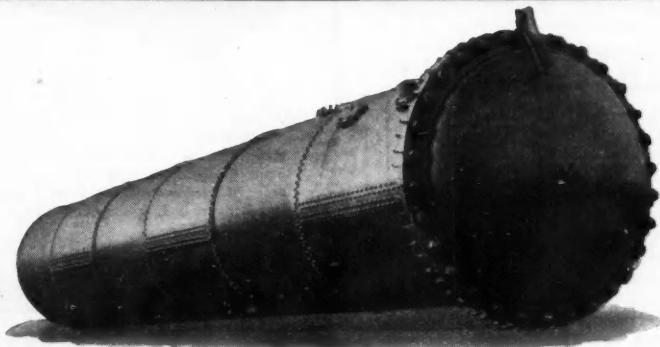
FROM Canada comes news that James A. Stenstrom has been named sales manager of Canadian Chemical Company Ltd., which is now erecting a large petro-chemical plant on a 430-acre site at Edmonton, Alberta. The sales office of the company will be in Montreal, and a selling organisation is now being established for domestic and foreign distribution.

An impressive list of aliphatic organic chemicals will be handled by Mr. Stenstrom for the new company, which is a Canadian affiliate of Celanese Corporation of America. Some of the chemicals to be manufactured—pentaerythritol, methanol, propylene glycol, dipropylene glycol, *n*-propanol and *n*-propyl acetate—have never before been produced in Canada. Other products which will be produced in volume are acetic acid, acetone, acetaldehyde, formaldehyde and *n*-butanol. All chemicals will be manufactured in sufficient quantity to meet the major portion of the Canadian demand, and several of these will also be available for export.

# Metallurgical Section

Published the first Saturday in the month

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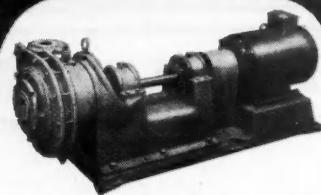
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## Metallurgical Section

### Photometric Determination of Iron Traces in Zinc and Aluminium

THE remarkable effect and importance of trace elements both in organic and inorganic chemistry have long been recognised, and not least in the metallurgical field, where trifling amounts of 0.01 per cent or less may markedly affect the properties of metals and alloys. For example, in high purity zinc graded at 99.995 per cent total impurities, mostly of Cu, Sn, Pb, Cd and Fe, cannot exceed 0.005 per cent, of which the Fe share may be no more than 0.001 per cent or less. The same applies to aluminium, and in both cases the Fe content may have important consequences. A relatively simple, rapid, and effective method of analysis suitable for works laboratory use is therefore essential. A great deal of important work has been done in this direction of late years. Dr. E. Eberius, of the A. G. für Zink-Industrie, Duisberg-Hamborn, Germany, has reviewed the literature and latest methods including the photometric as developed by his own company and others (*Angew. Chem.*, 1951, **63** (21), 513-519—7 November).

Of the 25 substances giving colour reactions with iron ions about five only need be considered here, namely,  $\alpha,\alpha'$ -dipyridyl, *o*-phenanthroline, salicylic acid, thiocyanate and the less sensitive sulpho-salicylic acid. The relative merits of these are compared in connection with the earlier work of A. Thiel and E. van Hengel, and others, but it is considered that some of the results at least need confirmation, especially in regard to sulpho-salicylic acid. In connection with this the literature is critically surveyed in somewhat greater detail, and an attempt made to clear up certain contradictions; more particularly to check up on the following points: (1) effect of acid concentration and of SSA (sulpho-salicylic acid) content; (2) sensitivity of the quantitative detection of iron in solutions free from foreign salt; and effects of (3) zinc, (4) alu-

minium, (5) zinc and aluminium contaminants, (6) anions.

1. *Effect of acid concentration and SSA content.* In preparing the solutions, 0.179 g. ferric oxide (Brandt) were dissolved in 50 ml. HCl and made up to 5 litres with double-distilled water; both acid and water were shown to be substantially free from iron by the dipyridyl test. In preparing solutions for the photometric tests, 20 ml. of the iron solution was pipetted into a 100 ml. flask, the prescribed amount of recrystallised SSA added, with double-distilled water (up to about 80 ml.), and the solution adjusted to the desired pH value with Lypham paper as indicator and  $\text{NH}_3$  or HCl. The photometer used was that of Have-mann, as shown herewith (Fig. 1) with air-cooling. Two photo-cells were provided; temperature control was satisfactory—without the disturbances sometimes caused in respect to solution absorption or otherwise; and polychromatic green and blue filters were fitted. With a constant iron content (500 gamma per 100 ml.) six series of tests were made with SSA contents of 2, 20, 100, 200, 1,000, and 2,000 mg., pH values ranging

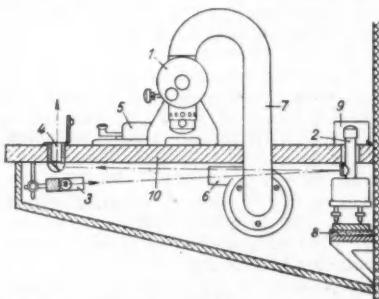


Fig. 1—1 Photometer, 2 Galvanometer, 3 Light source, 4 Mirror, 5 Key, 6 Fan, 7 Cooling tube, 8 Rubber sponge, 9 Protective cap, 10 Supporting plate

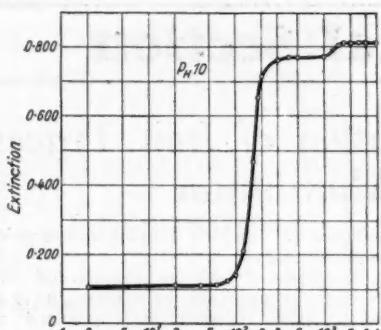


Fig. 2

in each case from 2 to 12. With each pH value measurements were made both with the green and the red filters in order to note the extent of the zone between red-acid and yellow-alkali, i.e., the red-yellow penetration in both regions of the spectrum. The results are graphed (Figs. 2 and 4). As is seen with increasing SSA content (with the red solution) sensitivity of the quantitative test and range of pH values increased—with extinction; and difficulties in reproducibility of results through slight errors in pH adjustments were insignificant with concentrations of 1,000 mg./100 ml. and over. With the yellow solution extinction was independent of pH values over 9 and a function only of iron and SSA concentration. In determining iron in aluminium it is fairly clear that there must be present a sufficient excess of SSA for the iron; and this would account for the large SSA additions used by Kusnetzov (*Zavoda. Lab.*, 1946, **12**, 278).

It is generally concluded, so far as concentration is concerned, that in working in the acid range of 1,000 mg. SSA/100 ml. and over, a pH between 3 and 5 is desirable but need not be kept exact to within 0.1. With the red complex only half the sensitivity at best is attained compared with the yellow. In the alkaline yellow region, after pH 9 has been reached or passed, and concentration is 1,700 mg. SSA/100 ml., further manipulations or refinements are unnecessary, and reproducibility is entirely satisfactory. It is therefore recommended, in determining iron in the absence of foreign salts, to work with the yellow alkaline solutions. Two g. SSA are added to the test

solution, and ammonia ( $d=0.91$ ) is added until there is change from red to yellow, then a further 20 ml. of ammonia is added, and the solution made up to 100 ml. Deviations from these figures of  $\pm 20$  per cent are immaterial.

2. *Sensitivity of the iron-sulphosalicylic acid (SSA) reaction.* The formula for calculating the molar extinction coefficient is given as follows

$$\epsilon = \frac{E}{d.c.F_e} \text{ cm}^{-1} \text{ Mol.}$$

where  $d$  is layer thickness,  $E$  extinctions, and  $c_{Fe}$  litre-molarity.  $\eta$  gives the Fe content in 1 c.c. with  $E$  equal to 0.001. The greater  $\epsilon$  so much the greater is sensitivity expressed as  $\eta = \gamma \text{ cm}^3$ . Results of earlier workers—Thiel, Woods, Hacker, etc.—and those of the author are tabulated for *o*-phenanthroline, thiocyanate, salicylic acid and SSA (red and yellow). These show that the first reagent (phenanthroline) is seven times more sensitive than the SSA-red, and 3.5 times more than the SSA-yellow, and the second (thiocyanate) 4.5 and 2.2 times more sensitive respectively; while the salicylic acid reaction is 0.7 and 0.3. The SSA-yellow reaction is considered quite sensitive enough for the purpose required. The lower values obtained by Geuer are explained as due to his use of monochromatic filtered light from a mercury lamp; and those of Thiel to his use of oxyacids (as buffer agent) and small doses of SSA. The SSA sensitivity is not fully used in practice, since reproducibility with the Havemann photometer is not  $\pm 0.001$  but  $\pm 0.003$ . Iron content per

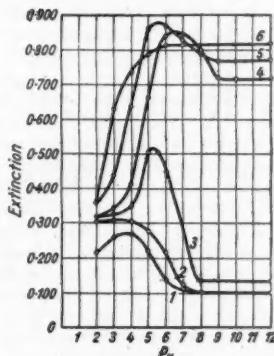


Fig. 3

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100 ml. and range of error for different layer thickness is indicated (e.g., for 1.0, 3.0 and 5.0 cm.).

3. *Effect of zinc.* Solutions containing 100 $\gamma$ , 300 $\gamma$ , and 500 $\gamma$  iron to each of which were added 500, 1,000, and 2,000 mg. SSA and 1,000, 2,000, and 5,000 mg. Zn, adjusted to pH values of 2, 4, 8, 12 (108 solutions in all) were photometrically tested. In all cases, both acid and alkaline, the zinc had no effect on extinction; and values corresponding exactly with those of zinc-free solutions were obtained.

4. *Effect of aluminium.* Results with acid aluminium salt solutions containing iron are available from other sources, so that only alkaline (ammonia) solutions were used by the author to see if the red reaction could be replaced by the more sensitive yellow. In zinc-containing solutions free from foreign salts and of definite SSA concentration, extinction values, as we have seen, remain constant; but in the presence of 0.5 g. aluminium—the amount commonly used in photometric iron determination—they are a function of the SSA addition. Therefore iron determination in ammoniacal SSA-aluminium salt solution is attended by some uncertainty which, together with the rather high consumption of reagent, does not compensate for the advantage of higher sensitivity as compared with the SSA-red reaction. In order to test the effect of small amounts of Al in the Zn, solutions were photometrically tested containing 2,000 mg. Zn, 50 mg. Al and 500 $\gamma$  iron in 100 ml. together with 100, 200, 1,000 and 2,000 mg. SSA, of pH values 4 and 12. In acid medium, Al was without effect; in alkaline medium, extinction was reduced with 200 mg. and less SSA; but from 1,000 mg. and upwards, extinction remained constant as when Zn and Al are absent.

5. *Effect of Zn and Al contaminants.* The effect of lead, copper and manganese was studied.

(1) *Lead:* In pure Zn up to 0.45 per cent and in ordinary commercial Zn up to 10 per cent, Pb may be expected. Zinc alloys, except Zn-Cu 4A, may contain Pb+Cd up to a maximum of 0.011 per cent, and the 4A alloy up to 0.9 per cent. Al and alloys are free from Pb, so that only the zinc plus lead combination requires investigation—in the present series a solution containing 2 g. Zn, 50 g. Pb as nitrate, and 2,000 mg. SSA.

In acid medium Pb is without effect. In alkaline, it is precipitated as an SSA compound without Fe. In Pb contents up to 10 per cent it was found that the SSA concentration and Pb content together had no effect on the Fe extinction value.

(2) *Copper:* This may be present in pure Zn up to 0.001 per cent and in crude up to 0.5 per cent. Zn alloys contain 0-4.5 per cent. In pure Al up to 0.1 per cent is present, in Al alloys up to 6 per cent, and in the group G Al-Cu up to 15 per cent. In the test for Zn-Cu 0.1 to 1.5 mg. (0.05 to 0.75 per cent) Cu per 2 g. Zn is added as sulphate. In the acid region Cu had no effect. In the ammonia region Cu was still tolerable using the blue filter to 1 mg./100 ml. Larger amounts must be dealt with either by cementation with copper-free Al foil, precipitation with H<sub>2</sub>S or thiosulphate, or by the method described later in connection with Zn and Zn alloys. The first, with Cu removed as cementation residue, is not recommended; on the other hand, in the cementation of a hydrochloric Pb- and Cu-containing solution with Al foil, the Fe remains quantitatively in solution. With the Al-Cu combination, Cu in acid medium up to about 20 mg./100 ml. has no effect. This agrees with the results obtained by Bauer and Eisen.

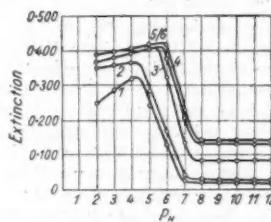


Fig. 4

(3) *Manganese:* This is not present in pure zinc, and in other grades or alloys up to about 0.3 per cent; in Al and alloys up to 2 per cent. In photometric tests with the acid red solution, Mn was without effect either for Zn or Al; but the effect was noticeable in alkaline (ammonia) solution, and the resulting brown colouring was investigated further under varying conditions. Curves show extinction values for Mn salt solutions without Zn or Al; with iron addition in which extinction was proportional to Mn concentration and Fe and Mn did not affect extinction; and with Al addition. In this last case

it was found that brown coloration was not entirely due to the Mn content, but was dependent also on Al concentration, on SSA content, and on time. Increasing Al content had a damping or depressing effect, Mn being constant, but this effect could not be easily controlled or reproduced, owing to uncertainties of time and atmospheric oxygen effects; so that Al alone was an unreliable factor in depressing the brown coloration. The Mn could be precipitated by Smith's permanganate reaction, and the precipitate contained no iron; but the use of this method is limited in practice to special cases, as no chloride may be present.

The use of a reducing agent to reduce or inhibit browning, e.g., hydroxylamine hydrochloride, proved to be very effective, and permitted reliable use of the photometric method (SSA plus ammonia) in Mn-containing zinc salt solution, often of value in rapid iron determinations. This agent could be employed, too, in Al salt solutions to inhibit browning. The author considers, however, that iron determination with SSA in ammoniacal solution is not to be recommended for Al and its alloys, as, with a much greater use of reagent, little more is accomplished than in acid solution (cf. Bauer and Eisen), and it is not sufficiently reliable for works use.

*6. Effect of anions.* The effect of these up to 5 g. anion/100 ml. concentration was studied, using the sodium salt. There was no effect from chloride, sulphate or nitrate.

Summing up the foregoing six sections it appears that, for zinc, an adaptable and useful method is available for iron determination, but in regard to aluminium no practically useful purpose would be served in changing over to an admittedly somewhat more sensitive method.

## Distribution of Steel

CONTROL of the distribution of alloy and non-alloy (carbon) steel, which was foretold by the Minister of Supply (Mr. Duncan Sandys) on 12 November, will come into effect as from 4 February, 1952, it was announced last week by the Ministry of Supply.

New arrangements will be similar to those in operation up to May, 1950, and no person may (from the operative date)—with certain exemptions under a Small Quantities

Exemption Clause—acquire or use specified types of steel unless he has an authorisation.

Authorisation will permit the consumer to acquire steel direct or to allow his subcontractors to purchase steel. Small consumers—consumers whose requirements are 25 tons or less a quarter including not more than 10 tons of sheets—should apply to their Ministry of Supply Regional Controller.

Present arrangements for allocating sheet steel and tinplate, terneplate and blackplate—which are already subject to distribution control—will remain unaltered. The new Order covers alloy as well as non-alloy steel, but consumers will receive separate authorisations for each type and also for sheet and tinplate.

Iron and steel stockholders will again need licences to acquire controlled types of steel for re-sale.

It will be illegal (subject to the small quantity exemption provisions): (a) for any firm or person to acquire or use controlled forms of steel unless an appropriate authorisation is held; (b) to dispose of such steel except to holders of authorisations.

Orders already placed for delivery on or after 4 February, 1952, will require an authorisation. A list of the controlled forms of iron and steel and the exemption for small quantities was published with the announcement of the Order.

## Non-Ferrous Metal Supplies

IMPROVEMENT in world supplies of lead was referred to by Mr. Henry Hopkinson, Secretary for Overseas Trade, in a written answer in the House of Commons on Monday (26 November). It was expected that requirements of British industry would be able to be met in 1952.

Dealing with other raw material shortages, Mr. Hopkinson said that supplies of tin for the United Kingdom should not cause any serious problems. Sulphur, copper and zinc were at present subject to allocation by the International Materials Conference, which would decide future supplies.

Stocks of sulphur and non-ferrous metals at the beginning of this month were given by Mr. Hopkinson, provisionally, as: Sulphur, 108,900 tons; virgin copper, 122,800 tons; refined lead, 45,000 tons; virgin zinc, 35,700 tons; zinc concentrates, 64,000; virgin tin (exclusive of producers' and Government stocks), 1,800 tons.

# Metal Finishing Practice

## British and American Methods Compared

PRESENT scarcity of materials and high costs are, of course, at present a major handicap in the United Kingdom to the replacement of plant, but even in more normal conditions the comparative unwillingness of the British worker to adapt himself to new methods or machinery has for long been apparent in industry.

This contrast with the U.S.A. is again emphasised in the report on 'Metal Finishing' issued this week by the Anglo-American Council on Productivity (3s. 6d.) in which the team found that there was a refreshing boldness in planning and a readiness to tear out obsolete plant as soon as a watertight case had been made for scrapping it. The well-known American enthusiasm for new ideas probably accounted for the ready manner in which technical staff was concentrated on specific jobs so that difficulties could be overcome with the least possible delay.

The team of 13, representative of users, plant and raw material manufacturers, under the leadership of J. N. T. Adcock, technical service manager, I.C.I., Ltd. (Paints Division), spent six weeks in the U.S.A. from 17 August to 29 September last year. Visits were paid to 21 plants, ranging in size from small jobbing shops to plants of the largest manufacturing organisations in the country.

### Metal Cleaning

Importance of metal cleaning and pre-treatment was clearly recognised. The conventional trichlorethylene vapour degreaser was extensively employed for the removal of oil and grease before painting. In two instances the use of perchlorethylene was noted. Because of its higher boiling point (248°F.) and heavy vapour, this was effective in the high shop temperatures experienced in the summer and often allowed the cooling arrangements at the top of the tank to be omitted.

Cleaning by immersion in a bath of hot alkali was not a common practice and had been almost entirely superseded by spray alkali or emulsion cleaning. There was also a clear appreciation of the need for careful control of phosphating solutions and every

effort was made to render the operation as foolproof as possible.

Water-washed booths with ample rates of air- and water-flow were being adopted for all major installations; a wide variety of coagulents for paint sludge was available but there did not appear to be any universal coagulant which would serve for all paints and all water supplies. The team was impressed by the saving in operating costs and raw material usage which was possible when paint overspray was reclaimed. This process was only possible when water-washed booths were employed and was also confined to cases where one type of paint was used in each booth.

### Convection Ovens Similar

Convection ovens were, in general, similar to those available in this country. Radiant heat stoves were mainly used for smaller work and there did not appear to be any trend towards their universal adoption. The unit construction gas radiant oven appeared to be little known.

As in this country, most of the paint used industrially is sold under the manufacturers' brand name and the composition is not disclosed. Thus, exact information on the composition of the paints seen was in most cases not available, but from their performance and application characteristics it seemed likely that the materials in wide use were basically the same in both countries.

For stoving finishes the most popular were still those based on alkyd/urea formaldehyde or melamine, while nitrocellulose continued to occupy an important place wherever quick-drying finishes were needed.

Very few of the newer types of surface coating material were seen during the tour. One firm was using a paint containing a proportion of a silicone resin for the protection of cylinder blocks and exhaust pipes, but the price of this resin continued high and its use was limited to special applications. At another factory vinyl stripable coatings were seen for protecting polished sheet during the forming operation and at another the use of a chlorinated rubber/alkyd composition when good adhesion to chromium plate was required.

There was a general tendency to check film thickness and few people appeared content with the idea that the number of coats gave a sufficient indication of film weight.

Reduction of polishing costs by direct and indirect means was a dominating feature of American metal finishing practice. Automatic and semi-automatic polishing machines were used much more extensively than here and this not only reduced the cost of polishing but also eased the labour demand—a factor of particular importance in the U.K., where for some years there has been an acute shortage of polishers.

American practice in this respect was, of course, favoured by the large outputs and long runs prevailing in the U.S.A., which justify the design and manufacture of specialised polishing machinery which, in consequence, is more readily available than here.

#### Spray Polishing Compounds

Also noteworthy was the increasing use of spray polishing compounds which provide a further step towards the complete mechanisation of the polishing process. For small parts, barrel deburring and barrel polishing were widely used and had reached a high stage of technical development.

Indirect methods of reducing polishing costs were also practised extensively. Thus, a copper undercoat was used on unpolished or partly polished steel components, primarily on account of the greater ease with which copper may be polished as compared with steel; as a further aid to polishing, bright or semi-bright copper solutions were employed on a large scale, and these gave the added advantage of high rates of deposition.

Electro-polishing or chemical bright dipping prior to plating or anodising were being developed in an attempt to reduce polishing costs.

The thoroughness of American cleaning cycles prior to plating and of rinsing facilities was striking. American practice was superior to the average British practice in this respect and it might well be that the relatively trouble-free operation of their large, fully automatic bright nickel installations derived from this fact. A particular instance of some importance was the almost universal use of cleaning and activating cycles interposed between nickel and chromium plating.

Recommendations made by the team included that management should make available as many cost data as possible so that the whole organisation could be aware of the need for carefully controlling costs, and that a much closer collaboration between design and finishing departments should be maintained so that the view of the finishing department on the practicability of a proposed design could be ascertained at the earliest possible moment.

In painting, attention should be given to the possibility of reclaiming paint from the sludge in water-washed booths, and more use should be made of film thickness measurements.

Automatic and semi-automatic polishing machines should be installed to increase productivity, reduce costs and counter the shortage of polishers, whenever the nature and quantity of the output justifies their use. General adoption of spray polishing compounds would be premature at this stage but their development should be watched.

Electro-polishing or electro-brightening as a substitute for, or ancillary to, mechanical polishing of metals prior to plating, and the chemical bright dipping of aluminium prior to anodising or plating are potentially valuable processes for reducing polishing costs and increasing output. Many of these processes have not yet reached a stage of development where general adoption could be recommended but some have proved successful and the subject merits close attention.

#### Cleaning Facilities Inadequate

Metal cleaning and rinsing facilities in many British plating shops are inadequate and should be improved.

Plating and rinsing troubles are frequently traceable to an unsuitable water supply. In such cases the use of de-ionised water should be considered.

Layout of plating shops should be reviewed to see whether improvements in flexibility and economy of production can be gained by adopting the simple though unorthodox combinations of machines noted in America.

The appropriate authorities should explore the desirability and practicability of instituting a co-ordinated electro-deposition research scheme with immediate open publication of results on the lines of the scheme operated by the American Electroplaters' Society.

## • PERSONAL •

MR. C. D. CALLIEU, O.B.E., D.S.C., has been appointed Marketing Operations Manager of Shell Chemicals, Ltd. Mr. Callieu who has hitherto been assistant sales manager will co-ordinate production and marketing plans with sales service to customers, to achieve the closest possible link between these important functions.

Mr. Callieu, who has been with the Shell Group for 20 years in a wide field of the group's activities, had a distinguished war record

with the R.N.V.R. He achieved the rare distinction for a volunteer officer, of being promoted to Commander while still at sea, commanding the 1st Mine Recovery Flotilla. He was awarded his decorations for his work in mine recovery, in which he was engaged throughout hostilities.

HANS F. DRESEL, of the Felton Chemical Co., Philadelphia, secretary of the American Association of Candy Technologists, intends to visit Europe during January and February, 1952, in order to meet those interested in this branch of food technology. He is hoping to visit some of the larger sweet and chocolate manufacturers as well as establishments manufacturing the raw materials and machinery used in the industry. He is anxious to learn of anything which might be of special interest to the American manufacturer such as special milk products, gelatin, pectins, packaging materials, etc.

As chairman of the Production Conference sponsored by the Pennsylvania Manufacturing Confectioners' Association which has been held for the past five years at Lehigh University, Mr. Dresel is also anxious to meet anyone who might be able and willing to lecture on subjects of interest to candy technologists in America.

DR. BERNARD LEWIS, internationally known physical chemist, who is chief of the explosives and physical sciences division of



the U.S. Bureau of Mines, North-eastern Region at Pittsburgh, Pa., has been granted a year's leave of absence to become director of powder and explosives research and development for the Ordnance Corps, Department of the Army, Secretary of the Interior Oscar L. Chapman announced recently.

Widely known for his research on combustion, flame, explosion of gases, explosives, and mine safety developments, Dr. Lewis graduated from Massachusetts Institute of Technology, and received advanced degrees in physical chemistry at Harvard and Cambridge Universities.

### Aluminium in W. Europe

AN appeal has been made by the Organisation for European Economic Co-operation urging its member countries to stimulate production of aluminium by increased supplies of electric power at economic rates.

Particular stress is laid on the fact that where power stations have been set up to serve aluminium producers, these should not be put to other uses.

Although output of aluminium has considerably increased this year it is pointed out by the OEEC that only about 75 per cent of the capacity is being used despite the improved position of hydro-electric power plants.

Estimated requirements of OEEC countries for aluminium in 1952-53 are 500,000 tons, and the greater part of this total should be able to be met from their own resources if the total capacity were used.

### Rare Earths Deposit

The Molybdenum Corporation of America, it is reported, has recently acquired a 41-square-mile tract of land in eastern California near the Nevada border, where the world's largest deposits of rare earth elements have been reported. The corporation expects to develop both the area and possible markets for the elements.

# • HOME •

### **Put to New Use**

The old bleach works in Heaton Mersey, Manchester, which was bought early this year by Norman Evans & Rais, Ltd., chemical manufacturers of Manchester and Cheadle is to be used for the manufacture of textile and fine chemicals. The works was originally owned by John Wallar and later by Sunshine Bleach, a Scottish firm.

### **Phosphate Alternatives**

The shortage of phosphates, and the high price of phosphates caused largely by the monetary situation may have a grave influence on agriculture and other branches of industry. A special interest and importance, therefore, is given to the forthcoming meeting of the Agriculture Group of the Society of Chemical Industry, where the subject to be discussed is 'Alternative Phosphatic Fertilisers'.

The lecturers and leaders of the discussion are Mr. T. P. Dee, of Fisons, Ltd., and Dr. Rice Williams, of the National Agricultural Advisory Service, Aberystwyth, and other distinguished speakers.

The meeting is on 11 December, 2.30 p.m., at the Royal College of Science, S.W.7.

### **New Carbonising Plant**

Plans were announced recently for a new £75,000 carbonising plant to be erected for the Blyth Division of the Northern Gas Board at the Spittal Works, Berwick. Work on the foundations will begin within the next week or two, but the plant which comprises intermittent vertical chamber ovens will not be in operation until early 1953. The ovens will replace the present horizontal retorts and will bring the Berwick works into line with the most modern in the country.

### **Fuel Economy Committee**

The Dunlop factory at Speke is proposing to set up in the near future a Fuel and Power Economy Committee to tackle the coal and electricity scarcity problem. The committee will be representative of the whole of the Speke factory. The company has already put into operation its own generators which will help carry the load during peak periods. Some production equipment is also being transferred from day to night shift.

### **To Supervise Work**

Process supervisors from the I.C.I. factory at Mossend have left Scotland by air to undertake supervisory work in a new I.C.I. ammonia plant in Portugal.

### **Parliamentary Committee**

There will be a meeting of the general committee of the Parliamentary and Scientific Committee on Tuesday, 4 December, at 5.30 p.m. in Committee Room 12. Lord Rothschild, chairman of the Agricultural Research Council, has kindly agreed to introduce three of the younger members of the staff of the Council, who will give brief talks on the following subjects:—Dr. K. L. Blaxter—Cows, Dr. R. Markham—Viruses, and Dr. J. W. L. Beament—Insects.

### **Notch Bar Testing**

The Joint Committee on Materials and Their Testing and the Institute of Welding have announced that they will hold a Symposium on recent developments in the notch bar testing of materials, and their relation to welded construction, at the Institute of Civil Engineers, Great George Street, London, S.W.1, on 5 December at 10 a.m. All papers will be pre-printed and distributed to those who ask to have them, on application to 2 Buckingham Palace Gardens, S.W.1. The discussion will also be published and written contributions to it will be welcome.

### **Steel for Aluminium**

Details of a plan whereby Britain will obtain more steel and the U.S. more aluminium, were announced last week in Washington, by Mr. Manly Fleischmann, the Defence Production Administrator. Under the plan Britain, during the first quarter of 1952, will obtain 25,000 tons of finished U.S. steel—or about 5,000 tons above previous quarterly allotments—and may place orders in America for 46,000 tons of so-called 'premium price' ingots. The U.S. will be permitted to buy a total of 22,045,000 lb. of Canadian aluminium—in five monthly instalments of 4,409,000 lb. each—diverted from purchases previously placed by Britain.

## • OVERSEAS •

### Output Declining

American sulphur producers have told the National Production Authority that their output in 1952 will probably not exceed 5,000,000 tons. The current annual rate of output, based on figures for the first ten months of this year, is 5,311,000 long tons.

A sulphur company spokesman said, however, that the present annual rate of production could not be taken as a reliable estimate of possible output next year. He explained that current inventories were considerably below those of 1950 and that output from a number of mining properties was steadily declining.

### Increased Tin Output

World production of tin-in-concentrates in September was estimated at 13,600 long tons, compared with 13,200 tons in August, according to advance statistics issued by the International Tin Study Group at The Hague last week.

The increase was mainly due to a sharp advance in production in the Belgian Congo to 1,351 tons, against 643 tons in August. Indonesian production also increased to 2,683 tons (2,505), but Malayan output decreased to 4,465 tons (4,923). Bolivian exports were lower at 2,159 tons.

### New Italian Zinc Works

The ECA Mission has announced that it is financing a new Italian zinc smelting works, which will increase zinc production substantially. Operations will begin at the end of the year. The ECA has advanced £2,200,000. The company operating the works is Sapex. Besides zinc, it will produce sulphuric acid and cadmium.

The Mission's chief declared that the new plant would strengthen the Italian economy and assist the U.S. stockpiling programme.

### Gas Turbine Vessel Crosses Atlantic

The first ocean-going ship to be driven by a gas turbine, the Shell tanker *Auris*, arrived at Port Arthur, U.S.A., on 19 November after a trouble-free voyage. She left the river Tyne on 28 October and covered the 4,905 miles at an average speed of 9.21 knots, including six days of continuous heavy weather, when speed was reduced from the normal 12 to seven knots.

### U.S. Raises Zinc and Lead Prices

In order to attract more foreign lead and zinc the United States has raised the price ceilings of both metals by two cents per lb. These new prices are still substantially lower than present world market prices. Steps are also being taken by Congress to repeal duties on these metals. This action is the result of negotiations with Canada, from whom the U.S. hope to receive more of these scarce metals.

### Plastics Beats Leather in Canada

Approximately 55 per cent of all footwear in Canada is being made with non-leather soles, according to reports from Goodyear Tyre & Rubber Company, with 'Neolite', a Goodyear product, supplying most of the market. Luggage is being considered as a possible market for 'Neolite' and the American parent company aims to obtain 10 per cent of the luggage market. In Canada the company has expansion plans which include the manufacture of ladies' handbags, briefcases, camera cases, belts, etc. 'Neolite' production is already six times that originally planned, say the company.

### New Mineral Found

A new mineral previously unknown to science has been found in Nevada, U.S.A., it is claimed, and named 'robinsonite' after Dr. S. C. Robinson, of Queen's University, Canada. A specimen of it is being sent to the National Museum in Washington where the biggest collection of minerals in America is kept—there are only about 1,600 well-defined species of minerals known. An announcement of the discovery was made officially in Detroit recently before the 32nd annual meeting of the Mineralogical Society of America. A sample sent to Queen's University in 1947 showed, from an X-ray powder picture, that the new mineral contained a typical pattern of boulangerite and a lead-antimony sulphide that had been produced synthetically by Dr. Robinson at Queen's University in the course of an investigation into lead-antimony sulphides. The hardness, colour and lustre of 'robinsonite' are reported to be the same as boulangerite.

## Publications & Announcements

BRITISH Drug Houses Ltd. have published a list of specifications for their 'M.A.R.' micro-analytical reagents which replace those that the company have followed for a number of years, mainly derived from the literature published by Pregl and his co-workers. The new specifications have been the result of further practical experience of the use of these reagents and suggestions for improvements from users of them. They have been approved by the Micro-chemistry Group of the Society of Public Analysts and other Analytical Chemists and by the Council of the Society as well as by other authorities in the field. It is probable, say the company, that with further developments more changes will be necessary and the specifications will be reviewed again.

\* \* \*

CINCHONA alkaloids' various uses in medical practice have been summarised in its latest booklet now available on request from the London Cinchona Bureau. It is no easy task even for the trained worker to whom comprehensive technical and medical libraries are available, to keep himself fully informed of the latest findings regarding malaria treatment. The bureau aims to gather and collate from world-wide sources all that is known about antimalarials generally, especially quinine and cinchona products. The new booklet entitled 'Quinine, Quinidine and Other Cinchona Alkaloids in Clinical Practice', after a brief historical survey, deals with the essentials of the pharmacology of the cinchona alkaloids; dosage; routes of administration; therapeutics of quinine, and data regarding cinchona compounds, etc.

\* \* \*

A NEW equipment for measuring mechanical quantities electrically and for indicating the results at a distance has been developed by the research laboratories of The General Electric Co. Ltd., and Salford Electrical Instruments Ltd. The system has a very wide range of industrial applications, say the makers, of which the following are typical: gas, liquid and steam pressures; liquid levels; compression or tension in girders, props, ropes, wires and struts; weights of large and small structures; positional indication. Operation is from the A.C. mains and the indications can be trans-

mitted directly over several miles. The basic principle of the system is that of a change of inductance in a circuit, and the inherent difficulties of earlier change-of-inductance systems, due to magnetic leakage, temperature errors and poor electro-mechanical efficiency, have been overcome by the use of an entirely new magnetic powder material 'Gecalloy PL.' This new system is extremely simple and robust and can be operated and maintained by unskilled personnel. Overall accuracy is high and is unaffected by variations of ambient temperature. Up to 30 per cent change of voltage and 10 per cent change of frequency can be tolerated.

\* \* \*

RECENTLY issued by HMSO (5s. 0d.) is *Colonial Plant and Animal Products*, Volume II, No. 1. This edition contains an interesting article (Part III) on the use of seaweeds in commerce. A major use for these is the production of meal for animal feeding stuffs. Some seaweeds contain high proportions of vitamins as well as minerals. Also included in the journal are reports of recent investigations at the Colonial Products advisory Bureau. Notes cover the production of peppermint oil in Washington and of lemon grass oil in Puerto Rico.

\* \* \*

THE Permutit Company has published two pamphlets on their base-exchange water softeners. One explains the troubles caused by hard water and the chemistry of the removal of both temporary and permanent hardness by base exchange resins. Softening and regeneration under manual control and automatic control are described, as well as a list of ion-exchange materials and some of the firms who use them. The second pamphlet describes the company's base-exchange water softener Type DL, showing a diagram of the plant.

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'NAFT' Magazine, the house journal of Anglo-Iranian, has just come out with its autumn number. Covering a wide variety of topics of news interest to all concerned with oil, it contains articles on the Sunbury Research Station, and on progress at the Isle of Grain where the company's new refinery is being built.



METALLURGISCHE VERARBEITUNG VON ALTMETALLEN UND RUECKSTAENDEN. By Edmund R. Thews. Carl Hanser Verlag, München. Vol. I, pp. 27 + 360 Dm. 22. Vol. II, pp. 290. Dm. 31.50.

Volume I deals with scrap white metals, while the second one mentioned below discusses scrap copper alloys. The timeliness of this comprehensive survey is particularly significant because of the importance that all fields of industry are now placing on economy, conservation and secondary sources of metal supply. The introductory chapter of the book describes in general the indispensable nature of old and scrap metals. Many new methods of regaining secondary metals and alloys from scrap and residues have been worked out in the Middle European countries and the United States, but these have remained secret for a long time, only a few references appearing in technical journals. The author has drawn on many sources of information which would be difficult to locate for one who is not expert in this respective field. His former book, written in English—'The Metallurgy of White Metal Scrap and Residues', New York, D. Van Nostrand Company, New York, 1929 is out of date, and the present edition is not only a revised but a much enlarged edition compiled from the author's own investigations. It covers the salvage and reclamation, preparation and treatment of scrap metals, and their working up, as well as refining, the fluxes, furnaces and other smelting apparatus, fuels, electric heating, etc. It contains statistics and tables, 72 illustrations, many instructive charts and diagrams and many sources are to be found in the book, which altogether outlines very thoroughly an industry of great importance.

The second volume of this author's work on the metallurgical uses of old metals, scrap and residues deals with old red-metals, for example, old copper and copper alloys. The book presents a collection of approved processes for the working of these, and a detailed description and criticism of the

applied apparatus, furnaces and other accessories. It describes the sorting and preparation of the scrap materials and the many types of furnace used according to the charge. Separate chapters deal with the gas contents and porosities of the charge, the deoxidising convertor process for mixed scrap, sorting of turnings and shavings, decomposition of car radiators and cables, etc. A final chapter describes the treatment and avoidance of lead-poisoning and zinc-fever which often occur in metal foundries. The book will suggest many improvements in the reclamation of scrap metals to foundry engineers and old metal dealers. It contains 57 illustrations, 40 tables and a list of some 450 special alloys based on copper contents and chemical properties. It concludes with a list of the German DIN-standards for brass alloys, and general classifications for non-ferrous scrap metals.—F.N.

LES PRODUITS DE LA SYNTHESE ORGANIQUE. By J. Lenoir (in French). Paper covers. Les Presses Documentaires, 28 Rue Saint-Dominique, Paris. 1951. Pp. 306.

This is a most up-to-date book dealing with all classes of organic substances and their methods of preparation. It is divided into sections named 'Intermediates' and 'Finished Products'. The part dealing with 'Intermediates' describes successively halogen derivatives, nitro and chloronitro compounds, alcohols, ethers, aldehydes and ketones, carboxylic acids and their anhydrides, acid chlorides, esters, nitriles, phenols and quinones, aliphatic and aromatic amines, sulphonic acids and sulphonyl chlorides, and heterocyclic nitrogen compounds. Under the 'Finished Products' it gives dyestuffs, perfumes, pharmaceutical products, plastics, explosives, photographic materials, solvents, plasticisers, synthetic tannins, products used in the textile trade, vulcanisation accelerators and anti-oxidants, insecticides, fungicides and rodent poisons. All descriptions are extremely brief and give characteristics, manufacture,

and applications. It is an excellent book for any student as it embodies the latest information and should fill gaps in an advanced student's knowledge of organic chemistry. As far as ordinary readers are concerned, the book suffers from a tremendous drawback—it gives no references. This means that any chemist who desires to repeat a process mentioned in this book, will have to make the usual tiresome searches which in the end may lead to information which is not at all helpful. However, it is a very readable and stimulating refresher.—S.P.S.

**QUATERNARY AMMONIUM COMPOUNDS.** By J. C. L. Resugan. United Trade Press, Ltd., London. 1951. Pp. 115. 15s.

This is a useful little book which will be of interest mainly to those who may have to use or direct the use of the new bactericides, rather than to the investigator in the field. It is also important to emphasise that the author is not (as his title might imply) reviewing the field of organic compounds containing the quaternary ammonium ion, but is dealing almost exclusively with surface-active agents containing the quaternary ammonium ion and having bactericidal properties. With these two reservations in mind there is very little with which to disagree.

The book is divided into two sections, the first dealing with the theoretical aspects grouped under physical chemistry and bacteriology, and the second section dealing with the applications of quaternary ammonium compounds in the food and beverage industries. The elementary facts and theory of the physical chemistry of surface phenomena are presented quite clearly in the first chapter though there is a tendency to oversimplify and introduce such statements as 'water has been used for ages as a cleaning agent', an observation with which most laymen will already be familiar.

In the second chapter which is concerned with anti-bacterial activity and toxicity there is a brief introduction to micro biology and an account of the action of chemical substances upon bacteria, the latter being expressed very clearly and satisfactorily. The question of the toxicity of the quaternary ammonium compounds is an interesting one and there has been some controversy on the subject. The author mentions in this chapter results which suggest that a normal man

weighing eleven stones could take as much as one ounce of such a compound without injury.

The chapter upon the chemistry of the quaternary ammonium compounds is probably the most disappointing. The space is almost entirely devoted to a discussion of the structures and properties and little indication given as to how the substances were manufactured. The illustrative diagrams are disproportionately large and this tendency toward large and clumsy diagrams is maintained throughout the book. Reduction of these to half size would not have impaired their usefulness and would have allowed the insertion of more information. There is also a slight tendency to use laboratory jargon and the section dealing with the properties of di-*n*-octyldimethylammonium bromide had the cryptic heading 'Non-Foaming Quaternary'.

On the other hand the chemical testing of the new bactericides is reviewed in an authoritative fashion and this part of the book contains a great deal of information not easily available elsewhere and of considerable value to the analytical chemist.

Technicians in the food and brewing industries will be more concerned with the remaining chapters dealing with the applications of quaternary ammonium compounds to sterilisation and preservation.

There is a short list of references up to 1951.—J.R.M.

#### British Standard for Centrifuges

The BSI announce that B.S. 767: 1951—'Hydro-extractors'—which was originally published in 1938, has been revised, and has now been re-published under the title 'Hydro-Extractors and Centrifugal Machines'. The method of calculating the stresses in the basket shell and hoops has been simplified as far as possible, and allowable stresses for the constructional materials have been brought into line with current practice. The standard in its revised form covers hydro-extractors and centrifugal machines having vertical, horizontal or inclined shafts, running at speeds from 400 to 3,000 r.p.m. It sets down certain principles governing the design, construction and operation of hydro-extractors and centrifugal machines used for the extraction of liquids from solids, but it does not apply to high speed centrifuges or separators.

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## Next Week's Events

### MONDAY, 3 DECEMBER

#### Society of Chemical Industry

London: Burlington House, Piccadilly, W.1. 6.30 p.m. W. A. M. Edwards: 'The Sulphuric Acid Industry—Changing Raw Materials and Processes'.

### TUESDAY, 4 DECEMBER

#### Society of Chemical Industry

London: 11 Chandos Street, W.1. 6.15 p.m. Microbiology Group. Dr. M. Horwood: 'Industrial Microbial Enzymes'.

London: Burlington House, Piccadilly, W.1. 5.30 p.m. Crop Protection Panel of the Agricultural Group. W. H. Read: 'Chemical Control of Glasshouse Pests and Diseases'.

#### Institution of Chemical Engineers

London: Burlington House, Piccadilly, W.1. 5.30 p.m. J. Matthews, H. F. Goodman and G. H. Botham: 'The Design of Process Equipment with Special Hygienic Requirements'.

Cardiff: University College of South Wales, Cathays Park, 7.15 p.m. South Wales Centre, Graduates' and Students' Section. I. G. Price (student): 'Extrusion Machinery in Plastics Manufacture'.

#### Textile Institute

Bradford: Midland Hotel, 7.15 p.m. Yorkshire Section. F. Happye: 'Structure and Regeneration of Protein Fibres'.

#### Electrodepositors' Technical Society

Birmingham: James Watt Memorial Institute, Great Charles Street. S. Wernick: 'Paint Application by Automatic Means'.

#### Institute of Metal Finishing

Birmingham: James Watt Memorial Institute, Great Charles Street, 6.30 p.m. Practical Platers' Forum. C. Wharrad in the chair.

### WEDNESDAY, 5 DECEMBER

#### Society of Chemical Industry

London: Burlington House, Piccadilly, W.1, 7 p.m. Food Group joint meeting with the Society of Public Analysts and Other Analytical Chemists. Discussion: 'The Food Standards Issue—What Does the Future Hold?' Introduced by Thomas McLachlan on 'Compositional Standards', and C. L. Heller on 'Microbiological Standards'.

#### Royal Institute of Chemistry

London: 2.15 p.m. Visit for registered

students to A. Boake Roberts, Ltd., Carpenters Road, E.15. 7 p.m. South-West Essex Technical College, Walthamstow, E.17. Tudor S. G. Jones: 'Byways in Chromatography'.

### THURSDAY, 6 DECEMBER

#### Chemical Engineering Group (SCI)

Bristol: 2.45 p.m. Visit to Avonmouth factory of Fisons, Ltd. 6.30 p.m. University Woodland Road (with the chemical department, Bristol University). K. Sharples and F. G. Shepstone: 'Chemical Engineering Applied to the Fertiliser Industry'.

#### The Chemical Society

Liverpool: University, 5 p.m. Professor H. W. Melville: 'New Developments in Methods for following Fast Chemical Reactions'.

Bangor: University College, 5.45 p.m. Joint meeting with the RIC and University College of North Wales Chemical Society. Dr. R. Spence: 'Chemistry and Atomic Power'.

#### Institution of Chemical Engineers

Chester: Queen Hotel, City Road, 7 p.m. North West Centre, Graduates' and Students' Section. Discussion on 'The Home Paper'.

#### Institute of Packaging

London: Waldorf Hotel, Aldwych, W.C.2. 6 p.m. Southern Area. 'Open Forum'. Non-members welcome.

#### Leeds Metallurgical Society

Leeds: University, 7 p.m. Film: 'Process Heating Equipment'.

### FRIDAY, 7 DECEMBER

#### Society of Chemical Industry

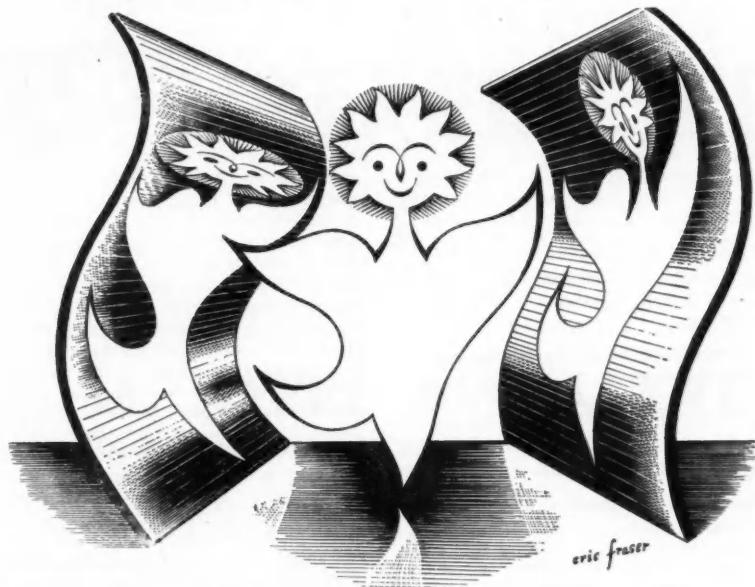
London: 2 Savoy Hill, W.C.2. 6 p.m. Joint meeting with the Royal Statistical Society (Industrial Applications Section, London Group). G. E. P. Box: 'The Planning of Experiments in the Chemical Industry'.

Manchester: Engineers' Club, Albert Square, 6.30 p.m. Joint meeting with the Chemical Society and the RIC. Sir Ben Lockspeiser: 'Scientific Problems in the DSIR'.

#### The Chemical Society

Birmingham: University, Edgbaston, 4.30 p.m. (with Birmingham University Chemical Society). Professor C. W. Shoppee: 'Cortisone'.

*[continued on page 750]*



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**The Chemical Society**

Southampton: University College, 5 p.m. (with Southampton University College Chemical Society). Dr. J. S. Anderson: 'Some Recent Developments in the Chemistry of the Heaviest Elements'.

**Institution of Chemical Engineers**

London: Britannic House (Anglo-Iranian Oil Co., Ltd.), Finsbury Circus, E.C., 6.30 p.m. Graduates' and Students' Section. Technical film. Discussion on Oil Industry.

**Society of Glass Technology**

St. Helens: Gas Showrooms, Radiant House, 6 p.m. T. V. Prosser: 'Batch Handling Problems'.

**Electrodepositors' Technical Society**

Sheffield: University, St. George's Square, 6.30 p.m. (with the Institute of Metals). H. G. Dale: 'Precious Metals in Industry'.

**SATURDAY 8 DECEMBER****Institution of Chemical Engineers**

Durham: 9.30 a.m. Graduates' and Students' Section, visit to Consett Iron Co., Ltd.

**Market Reports**

**GLASGOW.**—Business during the past week for all general chemicals has shown a surprising increase over the past fortnight and the majority of merchants and manufacturers reports increased demands. Certain sections of the trade are, of course, still quiet but taking everything into consideration the outlook appears to be quite healthy. A steady trade is being conducted with a very wide and varied export demand.

**LONDON.**—Strong price conditions have again been reported for industrial chemicals with the movement to the consuming industries in the aggregate remaining substantial. Demand for the textile finishing materials has perhaps been less active during recent weeks. Export inquiries have been fairly plentiful and the actual volume of bookings by traders has been satisfactory. The routine demand for soda products is steady at unchanged rates and pressure for supplies of most of the potash chemicals continues. Prices of coal tar products remain firm on a persistent demand.

**Chemical Oceanography**

THE comparatively recent interest that scientists have been exhibiting in the sea and marine life has been given the status of a separate branch of chemical science at the Texas Agricultural and Mechanical College, with Dr. D. W. Hood as its professor. The formation of this branch is described in a report to the American Chemical Society. It will, says the report, 'study the ocean and its boundaries as a chemical system, using both the data of all the marine sciences and the approach of all other systems of oceanography in the understanding and interpretation of such a chemical system.' Research in 'chemical oceanography' says Professor Hood, will extend the horizons of science to covering 71 per cent of the earth's surface, although the full practical value of this will not be realised until much more scientific information has been obtained about this vast reservoir of natural resources. However, a few obvious applications, says the professor, should be the extraction of important drugs, pharmaceuticals and other biochemical compounds from marine plants and animals, as well as food; the extraction of important metals from sea water or the sea floor (in addition to those already being produced); the elimination of harbour pollution and more effective control of industrial wastes; clues to the discovery of new fishing grounds and the establishment of new fishing areas in the best environment.

**British Columbia Timber Sought**

A \$75,000,000 pulp and paper development scheme by the Celanese Corporation of America has progressed so far that American officials have applied for a forest management licence for 1,000,000 acres of forest in British Columbia alongside the Arrow Lakes and the Columbia River. Castlegar, about 300 direct miles to the east of Vancouver, is reported to be the proposed site for the new development.

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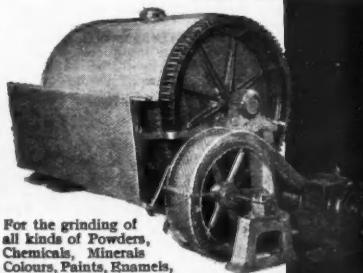


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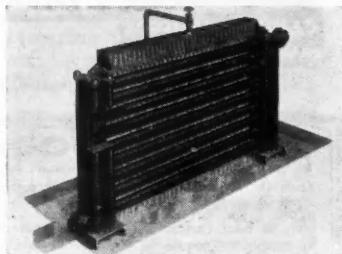
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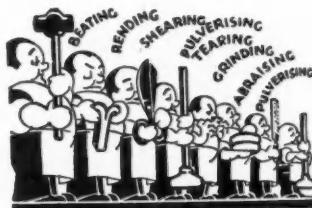
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